MAKING MODERN LIVING POSSIBLE

DLX
User Guide

DLX 2.0 - DLX 2.9 - DLX 3.8 - DLX 4.6

SOLAR INVERTERS

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1. INTRODUCTION

The *DLX* inverters are among the most efficient single phase grid-tied inverters on the market, which results in high yields from the solar array.

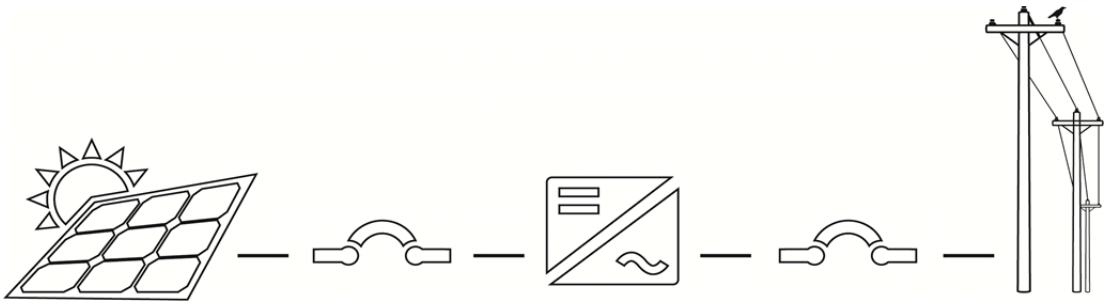


Figure 1.1: PV system overview

DC to AC

In a grid-connected photovoltaic system the interface between the solar array and the utility grid consists of an inverter, which converts DC power produced from the solar array into AC power adapted to the voltage and frequency of the utility grid.

***DLX* series**

The topology of the *DLX* series consists of an embedded high-frequency transformer, which provides galvanic isolation from the utility grid of class basic and thereby meets the strictest safety standards. Because of great adaptability and user friendliness, the *DLX* is the perfect choice for any photovoltaic (PV) installation. Different configuration options make it suitable for crystalline as well as thin-film modules, and make it easy and affordable to configure for various conditions and country-specific requirements. The compact and lightweight construction provides for easy and straightforward installation and maintenance.

Integrated Web Server

The inverter is equipped with an integrated web server, which records data on a daily, monthly and yearly basis. All information is displayed numerically and in graphs on a colored LCD screen on the front of the inverter. The data is also accessible either directly from a PC or via the internet. All settings and data are saved in the integrated logger, which provides storage of data with fifteen-minute intervals for one week, daily intervals for one year or weekly intervals for thirty years.

Automatic System

The system is fully automatic. The inverter starts up in the morning when the solar array generates enough power. During the day the maximum power point tracking (MPPT) function ensures the highest possible energy harvest. The inverter goes into 'sleep' mode at dusk when the solar array stops generating power.

2. PRODUCT OVERVIEW

This chapter gives an overview of the inverter with its supplied components, and how they are assembled. A brief explanation of how to unpack and handle the inverter safely is given, and symbols appearing both on the inverter and in this *User Guide* are explained.

2.1. Standards and Approvals

DLX inverters are compatible with the following directives and safety standards:

Table 2.1: Approved standards

Grid Protection	Safety	EMC
• VDE 0126 • G83/1 • C10/11 • EN 50438 • RD 1663, 661 • AS 4777.2/.3 • DK 5940 • ÖNORM E 8001-4-712 • IEC 61727 • VDE AR-N 4105	• EN 50178 • IEC 62103, 62109-2 • AS 3100	• IEC/EN 61000-6-2 (immunity) • IEC/EN 61000-6-3 (emission) • IEC/EN 61000-3-2/-12 (harmonics) • IEC/EN 61000-3-3/-11(flicker)

2.2. General Information

Several variants of the *DLX* are available for different configurations and country specific requirements.

2.2.1. Variants

The instructions given in this *User Manual* are applicable to the following models of *DLX* solar inverters:

- *DLX 2.0*
- *DLX 2.9*
- *DLX 3.8*
- *DLX 4.6*

2.2.2. Key Features

- World's highest peak efficiency for isolated inverters; up to 97.3%
- Flexible system configuration
- Monitoring 24/7
- Internal data logger with storage capacity of 15 minutes intervals for one week, daily intervals for one year or weekly intervals for thirty years
- MPPT range: 230 – 480 V_{DC}
- DC voltage range: 220 – 600 V_{DC}
- Automatic ON/OFF switching and temperature regulation
- Anti-islanding protection
- Reverse DC polarity protection (diodes)
- Theft protection

2.3. Symbols Used

The warning symbols used in this *User Manual* highlights **important information** on how to avoid hazards to equipment and people. **Pay particular attention when the symbols appear!**

Table 2.2: Warning symbols appearing in the manual

Symbol	Description
	DANGER: Situations where an immediate hazard could cause serious injury or death to workers and/or the general public if not avoided.
	WARNING: Situations where a potentially hazardous condition exists that could result in the death or serious injury of workers and/or the general public if not avoided.
	CAUTION: Situations where a non-immediate or potential hazard presents a lesser threat of injury that could result in minor or moderate injuries to workers and/or the general public.
	NOTICE: Situations where a non-immediate or potential hazard presents a risk to damage of property and equipment. May be used to indicate important operational characteristics. There is no "Safety Alert" or attention symbol present in this situation.

2.3.1. Labels

The product label is attached to the lower right side of the inverter housing. It contains important identification parameters and characteristics for the inverter, and must be clearly visible after installation.

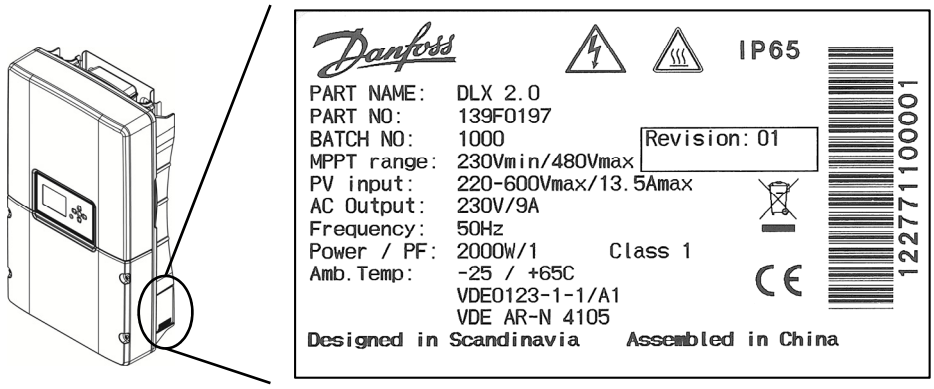


Figure 2.3.1: Product label

Table 2.2: Symbols appearing on the product label

Symbol	Description	Symbol	Description
60 min	**Discharge time 60 minutes:** High voltages may be present inside the inverter for 1 hour after switch OFF.	CE	**CE Marking:** The product meets the EU safety, health and environmental protection requirements.
	***User Manual*:** The safety precautions and instructions in this manual must be read and understood prior to installation.		**Disposal:** Do not dispose in general waste! Collect the various parts separately and recycle them according to state and federal regulations.
	Hot Surface: The heat sink on the back of the inverter can reach a temperature of 90 ° C/194 ° F.	S-No 104801100008	**S – NO:** Serial Number for inverter identification.
	Danger: Shock hazards - high voltages are present.	⎓	**DC:** Direct current terminal.
	Grounding: Ground terminal.	~	**AC:** Alternating current terminal.

2.4. Unpacking and Inspection

Follow these instructions in this section to unpack and lift the inverter safely and to prevent injury and equipment damage.

2.4.1. Shipping Damage

The *DLX* inverters are thoroughly checked and tested in accordance with international standards and approvals prior to dispatch. They are carefully packed before shipping. However, if any damage to the inverter is found when delivered, please provide feedback to your distributor immediately!

2.4.2. Lifting and Carrying the Inverter

Considering the inverter's weight of **20-22 kg** (depending on model), lifting and carrying the inverter must be correctly performed to prevent back injuries.

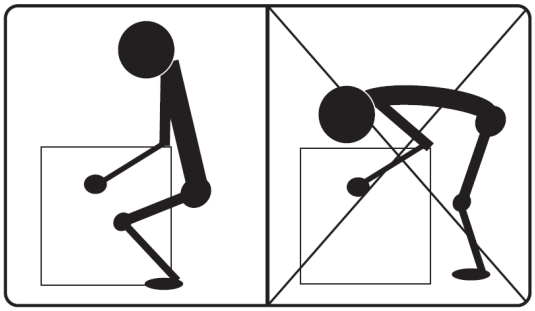


Figure 2.4.1: Correct lifting of the inverter

- When lifting bend the knees and keep the back straight.
- Lift carefully, hold the inverter close to the body and let the leg muscles do the work.
- Turn the whole body as one unit to avoid twisting the lower back.
- Carry the inverter close to the body.

2.4.3. Unpacking

Unpack the inverter as follows:

- Place the box in position, with the top clearly visible and according to the arrow markings on the packaging.
- Cut the seal, and open the box.
- Take out the lock clip, the bag with accessories and the *Installation Guide* lying on the upper section of the foam packaging material.
- Remove the upper part of the foam packaging material.
- Both sides of the inverter case are narrowed in order to get a better grip on the device. Lift up the inverter carefully out of the box using the "handles" illustrated in *Figure 2.4.2*.
- Remove the lower section of the foam packaging and take out the inverter mounting bracket.
- Store all the original packaging for possible later reuse.

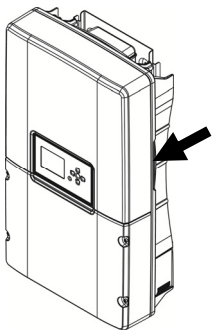


Figure 2.4.2: "Handles"

After unpacking the inverter safely, check that all components are present and in an undamaged condition.

2.4.4. Scope of Delivery

- *DLX* single phase inverter
- Mounting bracket
- Installation Guide
- Accessories: grounding strap, bracket screws, lock clip, extra type label

NOTICE

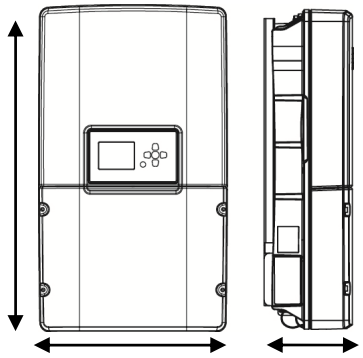
The mating parts of the connectors are not part of the standard scope of supply, and must be provided by the system installer.

2.4.5. Inverter Structure

The housing of the DLX inverter is designed to:

- IP 65 for indoor or outdoor use.
- Provide a degree of protection from dirt, rain, sleet, snow, dust, water, and corrosion.
- Be undamaged by the external formation of ice on the housing.

2.4.5.1. Mechanical Dimensions

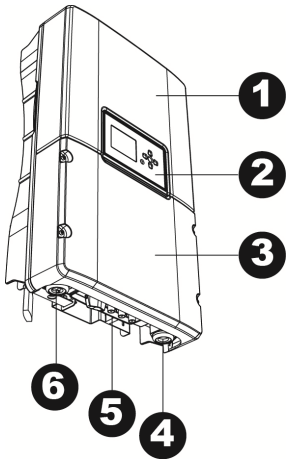


H: 610 mm
W: 353 mm
D: 158 mm

Figure 2.4.3: Mechanical dimensions

2.4.5.2. Front Covers

The front surface of the inverter consists of an upper and a lower cover.



1. Upper cover
2. Display
3. Lower cover; customer connection area
4. AC output
5. DC input
6. Network input

Figure 2.4.4: Inverter structure

The upper cover may only be removed by *Danfoss* authorized personnel. Removal of the upper cover by unauthorized persons voids the warranty!
The lower cover protects the customer connection area, and may be removed by the system installer for electrical connection and maintenance of the inverter.

Removing the Lower Cover

The lower cover protects the connection area in the inverter and, if provided, the inbuilt combiner box called the Stringbox.

WARNING

The inverter is charged with high voltages, and removal of the lower cover may only be performed by qualified persons.

- Turn OFF the DC switch.

DANGER

Always disconnect the PV array cables from the inverter after turning the AC and DC **OFF**, but before removing the covers, as the PV array can supply up to 600 V_{DC} to the inverter when exposed to sunlight.

- Remove the four screws on the lower cover with a 4 mm hex key.
- Take the cover off carefully.

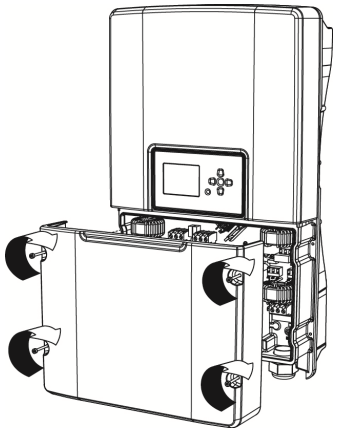


Figure 2.4.5: Lower cover

- Store the lower cover and screws safely to avoid loss or damage.
- Fasten the screws on the lower cover with a torque of 1.0 Nm

CAUTION

Never remove the inverter lower cover in wet conditions! Removal of the inverter lower cover during rain or in damp conditions can damage sensitive internal electronic components.

3. SAFETY PRECAUTIONS

This chapter contains instructions on how to install, operate and maintain the *DLX* inverters safely. These safety precautions must be read thoroughly and understood prior to the installation. Failure to follow the safety precautions may result in injury or death, and may void the warranty.

3.1. General Preparations

The *DLX* inverters contain no user serviceable parts, and installation and maintenance must be performed by authorized persons, who have qualified knowledge about the local and national electrical regulations in force and follow the instructions in this *User Manual*.

NOTICE

The safety precautions and instructions in this *User Manual* must be read thoroughly to be able to install and operate the inverter correctly.

3.1.1. Connections

Contact the local utility company for interconnection agreements and power approval before connecting to the grid.

NOTICE

To ensure safe and correct electrical connection of the inverter and prevent injury to persons or damage to the equipment the electrical wiring and connection must be performed by **qualified persons**.

DANGER

Never work with live wires! Prior to the electrical connection, the AC circuit breaker(s) and the DC switch(es) must be turned OFF to ensure that the terminals are discharged and safe to work on.

- Read the instructions and cautions on the PV modules prior to the electrical connection.
- Use the connectors as per the manufacturer's instructions only.
- The inverter must be connected to a dedicated AC circuit. No other devices should be connected to this circuit.

WARNING

Never remove cables during operation! The inverter is charged with high voltages, and removal of cables during operation may cause arcing

3.1.2. Operation

The inverter must only be operated in accordance with the information in this *User Manual*.

NOTICE

The *DLX* is a grid interactive inverter and must be used exclusively for its designed purpose, which is to convert PV-generated DC electricity into AC electricity to feed into the grid

- The inverter must be operated in its original and technically intact condition without any unauthorized modifications.
- Always keep the values of operation within the limits given in the technical specifications, due to the risk of possible inverter damage.

CAUTION

Keep the voltage and current within the specified limits! The open circuit voltage, V_{OC}, must never exceed 600 V_{DC} under any conditions. The voltage generated by the PV modules is inversely proportional to the temperature: at lower temperatures the PV voltage increases from the product label rating and at higher temperatures the PV voltage decreases from the product label rating.

- Unintended use may damage the inverter or other electrical equipment, may interfere with the operation of the inverter, or it can, at worst, cause injury or death to persons operating and maintaining the inverter.
- Ignoring the instructions and guidelines in this *User Manual* and not performing regular maintenance is considered as misuse of the inverter.

3.1.3. Maintenance

Prior to service and maintenance the inverter **must always be disconnected** on both the AC and the DC side and be **fully discharged. Refer to** *8.1. Switch-Off*.

NOTICE

Accessing the upper inverter section invalidates the warranty. The inverter covers are to be opened only by qualified persons due to danger of damage to internal components.

- The inverter lower cover must only be taken off during electrical connection and maintenance or repairs.
- No unauthorized modifications may be done to the inverter. Contact the system installer or the distributor in case of failure.
- Regular maintenance must be performed to maximize the life expectancy of the inverter. Refer to *8.2. Regularly System Inspection*.
- A safety component must always be replaced with the same type and rating.

3.2. Site Preparations

Observe the following precautions when mounting and installing the *DLX* inverter on a suitable site. This is crucial to maintaining the efficiency of the inverter!

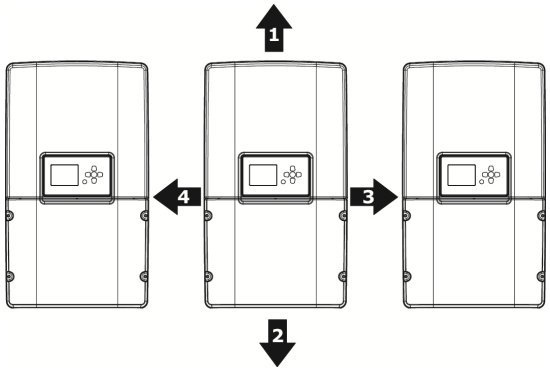
3.2.1. Mounting

Sufficient ventilation and appropriate ambient temperatures are needed to prevent temperature build-up inside the inverter, which could lead to possible power losses.

CAUTION

Insufficient cooling may lead to degradation of performance! Ensure sufficient air space around the inverter and unblocked ventilation openings for optimum cooling and efficient operation.

Observe the minimum distances below to maintain optimal cooling.



1. 400 mm
2. 300 mm
3. 150 mm
4. 150 mm

Figure 3.2.1: Minimum distances for optimal cooling

WARNING

Correct installation prevents the inverter from falling from the wall. The mounting surface must be suitable for the weight (20-22 kg) and temperature (90° C) of the inverter.

- The inverter must be mounted in a vertical position.
- Keep the lower cover closed when mounting the inverter to avoid damage to internal components.
- It is recommended that the inverters are not installed in living areas due to possible noise levels of the inverters.
- For ease of inspection and maintenance of the inverter, the display should be at eye-level, and the product label must be visible and the connection area readily accessible.

3.2.2. Installation

The installation of the inverter must be performed in accordance with the relevant local and national electrical regulations!

DANGER

Only persons who are qualified to install high voltage electrical equipment and are familiar with the electrical regulations applicable to the installation site may install the inverter. This to ensure a safe installation and prevent electrocution!

WARNING

Protect the inverter from flammable and explosive environments to avoid fire, as the inverter heat sink can reach temperatures of up to 90° C during long-periods of high performance operation.

- Ensure a longer life and optimum performance of the inverter by installing it in a clean, non-dusty, dry and cool environment
- Ensure a non-flammable and non-explosive environment to avoid fire.
- For optimal operation conditions the ambient temperature should be between -25 °C and +65 °C. If the temperature rises above +45 °C the inverter may start to reduce output power to protect internal components.
- Non-condensing relative humidity must be between 4 % and 99 %.

NOTICE

Avoid exposing the inverter to direct sunlight! Direct sunlight may cause yield losses, as direct sunlight causes increased internal temperatures that can lead to reduced power output. Also, direct sunlight may cause degradation of the LCD screen quality.

CAUTION

The inverter should be installed on a location where people cannot accidentally come in contact with the rear inverter surface, due to temperatures up to 90°C..

- The inverter is suitable for outdoor operation, but should be sheltered from direct sunlight, snow, rain, dust and sand.
- Location should be in proximity to the PV arrays to minimize DC losses.

3.3. Safety Equipment Required for Grid Connected Systems

Ensure compliance with the local and national electrical regulations to satisfy the safety equipment requirements.

NOTICE

Safety equipment that meets the requirements for both the DC and AC operations must be provided and installed by the system installer in compliance with the local and national electrical regulations, and to prevent personal injury and protect the equipment.

3.3.1. Disconnection Devices

Disconnection devices, **switches or circuit breakers**, enable a shut-off from the power source during operation. They protect the current-carrying conductors and other system components from power surges and system malfunctions, and help to shut down the inverter safely for maintenance and repairs.

- Both AC circuit breaker(s) and DC switch(es) are recommended to facilitate maintenance work and repairs of the inverter.
- The disconnect devices must conform to the local and national electrical regulations, and have an interrupt rating sufficient for the voltage and current available in the circuit.
- Each disconnection device must be readily accessible and operable without exposing the operator to live parts. All devices must be permanently marked for their purpose.

3.3.2. Overcurrent Protection Devices

Overcurrent protection devices, **fuses or circuit breakers,** prevent the circuit conductors from overheating as a result of overload, short circuit or ground fault.

- An overcurrent protection device is required on every current carrying conductor.
- If a fuse blows or a circuit breaker trips the cause should always be determined before replacing or resetting them.
- It is recommended to install an ***RCD*** (Residual Current Device) of ***type A*** between the AC grid and the inverter, to be able to detect leakage current and interrupt fault paths. The needed detection range must comply with the relevant local and national electrical regulations!

3.3.2.1. AC Fuses

- AC fuses protect the supply conductors between the inverter and the utility grid.
- AC fuses must be provided by the system installer.
- Recommended rating for the AC fuses is as per the local and national electrical regulations.

Table 3.2: Suggested AC current characteristics and fuse rating

Inverter Model	Max AC Current	Fuse Ratings	Tripping Characteristics	Type
DLX 2.0	10.5 A	13 A	B or C	Double Pole
DLX 2.9	15.2 A	20 A		
DLX 3.8	19.7 A	25 A		
DLX 4.6	23.0 A	25 A		

3.3.3. Surge Protection Devices

Overvoltage protection is used to prevent voltage surges through sensitive equipment. The *DLX* inverters are equipped with *Temperature protected Metal Oxide Varistors (TMOV)* on both the DC and the AC side, which conduct excessive current from voltage surges to ground.

- PV systems mounted in an open or exposed environment need added protection on both the DC and AC side, as they can act as lightning rods.
- When the conductors are exposed to transients, their behavior limits the effectiveness of a surge arrester. One or more surge arresters are needed in installations with long conductors to obtain the required level of protection.
- Always use qualified assessment when selecting the appropriate kA ratings for the overvoltage protection device!
- The *DLX* inverters are designed for category B: 100 kA – 150 kA per phase.

4. INSTALLATION

This chapter describes how to install the inverter correctly, both mechanically and electrically, and details important issues related to the installation. **This information is addressed to qualified persons**, who are educated in installing high voltage electrical equipment and who follow the installation order as described in this *User Manual*.

DANGER

All work on the inverter must be performed with all voltage and current sources disconnected, as contact with live wires may cause serious injury or death!

NOTICE

The *Safety Precautions* (Refer to *3. Safety Precautions)* and the following detailed installation procedures in this chapter must be read carefully prior to installation.

4.1. Checks prior to Installation

- ☑ Make sure that both the AC circuit breaker(s) and the DC switch(es) are OFF to prevent shock hazards during the installation of the inverter.
- ☑ Check that the PV and the grid specifications are compatible with the inverter specifications. Refer to *10. Technical Data*.
- ☑ All electrical installations shall comply with the current local and national electrical regulations at the installation site.

4.2. Mechanical Installation

The mounting surface and the mounting method must be suitable for the inverter's weight, dimensions and possible housing temperature. Refer to *10.Technical Data*.

WARNING

Follow the installation instructions carefully to prevent poor performance or possible lethal consequences.

4.2.1. Wall Bracket

Depending on the mounting surface, different mounting methods may be required to secure the wall bracket. The system installer is responsible for selecting the correct type and number of fixings suitable to support the weight of the inverter on the mounting surface.

- The bracket is designed to support 80 kg
- The inverter must be mounted in a vertical orientation!
- Mount the inverter in compliance with the minimum distances to ensure optimum cooling. Refer to *3.2.1. Mounting*. This is important with several inverters installed!
- The recommended height for the connection area is: 1000 - 1400 mm above floor level.

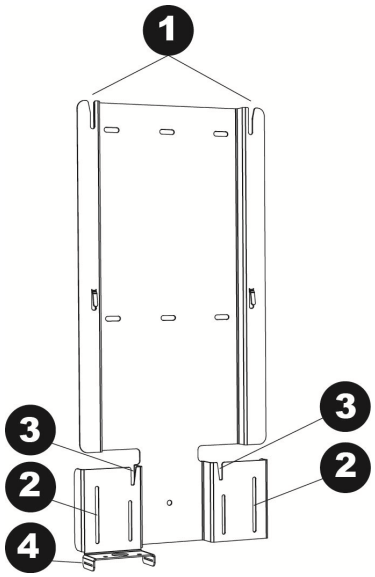


Figure 4.2.1: Inverter bracket

1. Carrier slots for the inverter
2. Steering slots for the inverter
3. Carrier slots for the Stringbox
4. Fixing clip

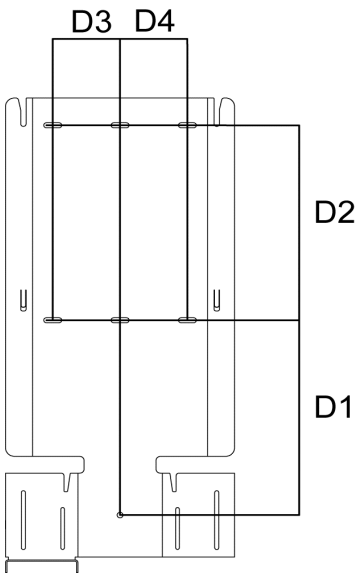


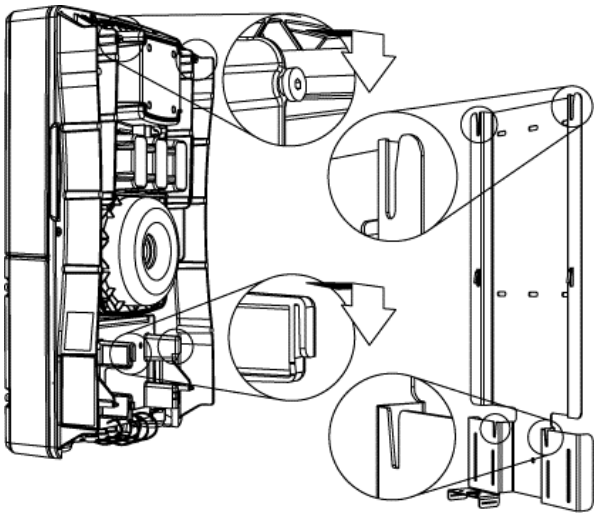
Figure 4.2.2: Distances between the fixing screws

D1. 232.5 mm
D2. 232.5 mm
D3. 75 mm
D4. 75 mm

- Mark the bracket holes on the mounting surface using a spirit level and the bracket as a template to ensure that the bracket is correctly level.
- The mounting bracket should be fastened to the studs of a dry wall or to a concrete/masonry wall.
- Drill the holes and fasten the bracket with the number of screws required to support the hanging weight of the inverter.
- Fasten the inverter bracket to the wall with minimum 2 fixings.
- The installer is responsible for selecting the correct dimensions of the fixings.

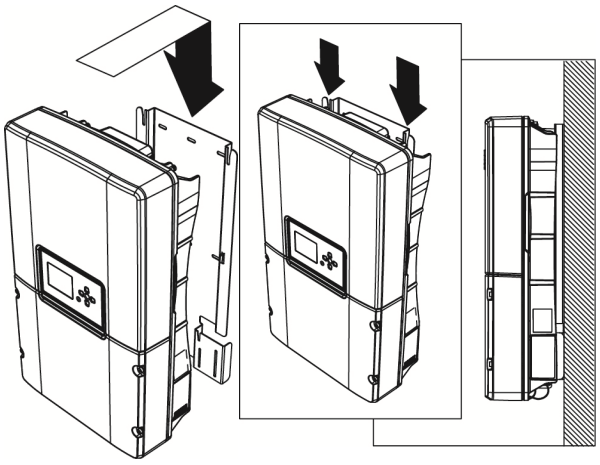
4.2.2. Inverter

Attach the inverter to the mounting bracket as follows:



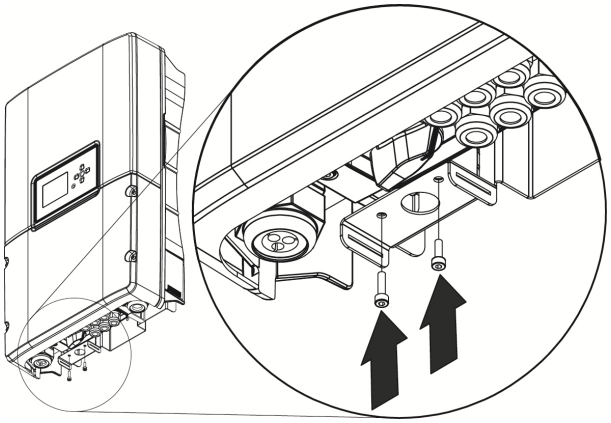
- Locate the hooks for the carrier slots on the upper back of the inverter.
- Locate the hooks for the steering slots on the lower back of the inverter.
- Use the locating pin taps on the Stringbox.

Figure 4.2.3: Hooks on the back of the inverter



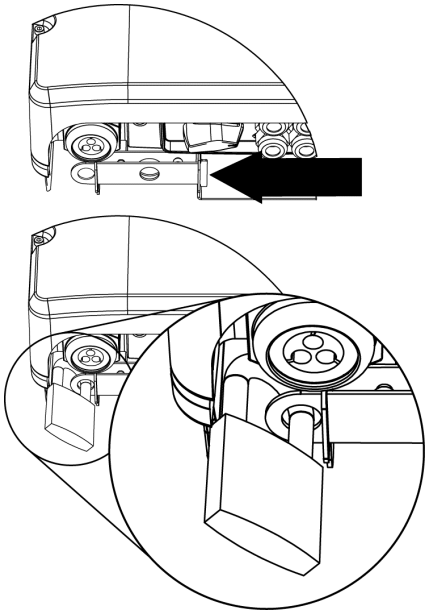
- Lift the inverter and guide the upper hooks into the slots on the bracket.
- Align the lower hooks into the slots.
- Slide the inverter onto the bracket.

Figure 4.2.4: Inverter onto bracket



- Ensure that the inverter is correctly aligned and secure in the bracket rails.
- Using a 3 mm hex key, tighten the fixing clip with one screw into the inverter and one into the Stringbox (if present).
- Recommended torque is 1.0 Nm

Figure 4.2.5: Screws through the fixing clip



- For theft protection: guide the lock clip through the fixing clip, and fasten with a padlock.
- The padlock is not a part of the scope of supply.

Figure 4.2.6: Theft protection

NOTICE

Check that the inverter is properly fastened and secured to the bracket prior to the electrical wiring.

4.3. Electrical Installation

Correct electrical connection is critical for achieving a safe, long-term and reliable operation of the entire PV system.

NOTICE

The electrical connections on the AC and DC side must be performed by **qualified persons** and comply with local and national electrical regulations and the instructions detailed in this *User Manual*.

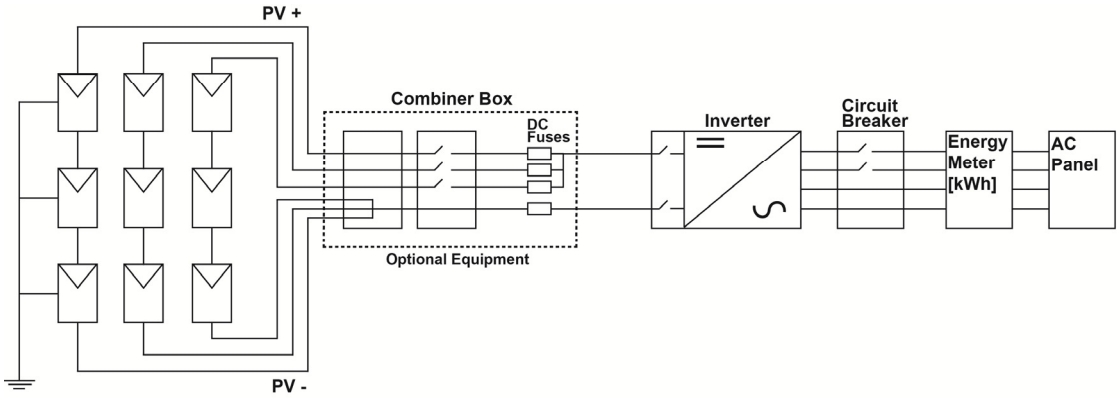


Figure 4.3.1: Simplified PV system overview

4.3.1. Conductors

Two important criteria must be considered in the selection of conductor sizes, namely ampacity and voltage drop. Using correctly sized conductors improves the efficiency of the PV system.

- **Ampacity** refers to the current-carrying capacity of the conductor. The larger the conductor is, the greater its capacity to carry current.
- **Voltage drop** is the loss of voltage due to cross section, current flow and length of the conductor. It is recommended to minimize the system conductor voltage losses, as voltage losses are equal to loss in energy yield.

CAUTION

The conductor cross section area and the disconnector ratings must conform to the ratings required by local and national electrical regulations.

- Use adequately sized conductors with the correct temperature rating and sunlight resistance.

CAUTION

The conductors must be listed for PV applications and the site environment and have the correct color coding to avoid material damage and bodily harm.

- The insulation color-coding of electrical conductors must be understood in order to ensure safe and efficient installation, maintenance and repairs. Ensure compliance with the relevant local and national regulations.
- Secure conductors so that they are kept away from objects that can damage the insulation (e.g. sharp edges).

4.3.2. Connection Area

Prior to the electrical connection the inverter lower cover must be removed. Refer to *2.4.5. Inverter Structure*.

4.3.2.1. Stringbox with DC Switch

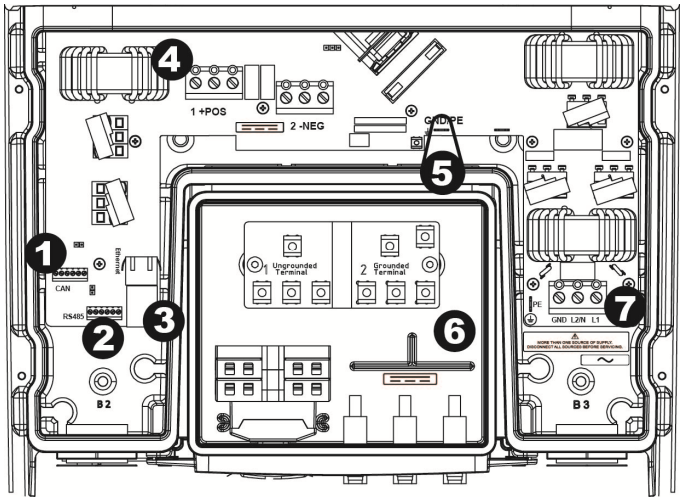


Figure 4.3.2: Customer connection area with Stringbox equipped with DC switch

1. CAN bus terminal
2. RS-485 terminal
3. Ethernet port
4. Internal DC terminal blocks, ***+POS*** and ***-NEG***
5. Internal DC ground receptacle, ***GND/PE***
6. Stringbox with DC switch
7. Internal AC terminal block

4.3.3. Grounding

Proper grounding of the entire PV system limits voltage surges, gives a common reference point for the conductive parts and facilitates the operation of the overcurrent protection devices.

DANGER

Grounding should be carried out by qualified persons only, and comply with local and national electrical regulations to prevent shock hazards.

- The PV strings may be ungrounded, or grounded through either the negative **or** the positive string conductors.
- The grounded DC conductors are connected to ground via the grounding strap.
- The grounded conductors must be sized according to the local and national electrical regulations, and only carry current when electrical malfunctions occur.
- Follow the safety instructions and specifications from the different PV module manufacturers regarding grounding requirements.
- All metal parts of the *DLX* inverters are electrically bonded to ground through the terminal labeled ***GND*** in the AC terminal block.

CAUTION

If the positive **or** negative PV conductors are grounded, then the grounding strap must be connected to the ***DC ground terminal*** and the system must **NOT** be grounded at any other point, as voltage potentials can appear and possibly damage electrical components.

A minimum cross section area of 6.0 mm^2 / 10 AWG is required for the ground wire connection.

4.3.4. DC Connections (PV)

The DC connections include wiring from the PV modules, possibly through a combiner box, to the inverter. The inverter may be configured with the optional Stringbox.

DANGER

Always disconnect the PV array before starting the connection on the DC side! Charged DC terminals pose a risk of serious injury or death as the PV array can supply up to 600 V_{DC} to the inverter when exposed to sunlight.

4.3.4.1. Array Configuration

A PV string consists of a certain number of PV modules connected in series. Strings can be connected in parallel forming an array and attached to the inverter. The *DLX* inverters have a large voltage range, and several feasible PV string configurations are possible. Follow the module manufacturer instructions, and the local and national regulations when configuring the PV array!

- The **grounding configuration** of the PV array and the connection to the DC terminals depend on the module technology used and the local or national electrical regulations.
- The inverter is delivered from the factory in **an ungrounded PV string configuration** as standard, but may be configured for **positive or negative grounded PV strings**.
- The configuration of a **negative grounded PV string** differs from an ungrounded PV string with the addition of a grounding strap.

- The configuration of a **positive grounded PV string** differs from an ungrounded PV string by the connection of the cables to the DC terminal blocks and the addition of a grounding strap.
- **Array configuration** depends on the module technology used. Both the positive and negative DC terminal blocks have three pairs of inputs, which allow three strings to be connected in parallel. Due to the inverter having **one MPP-tracker** the **PV power** should be identical for every string.

NOTICE

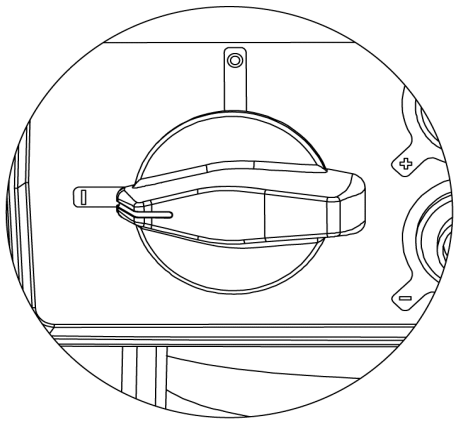
Maximum Voltage: The open circuit voltage, V_{OC}, must never exceed 600 V_{DC} under any conditions. The voltage generated by PV modules is inversely proportional to the temperature; at lower temperatures the PV voltage increases from the nameplate rating and at higher temperatures the PV voltage decreases from the nameplate rating.

4.3.4.2. Stringbox

The Stringbox is attached to the bottom of the inverter, and provides PV string connection via the wiring that runs through the plug-in connectors. A DC disconnect switch is provided and mounted in the Stringbox.

NOTICE

Before removing the lower cover to access the connection terminals ensure that the DC switch (if supplied) is in the **OFF** position, and the PV array cables are disconnected.

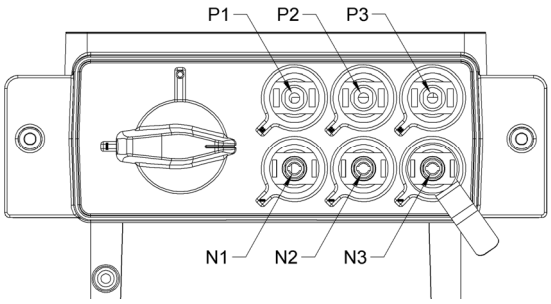


I = ON
0 = OFF

Figure 4.3.7: DC disconnect switch

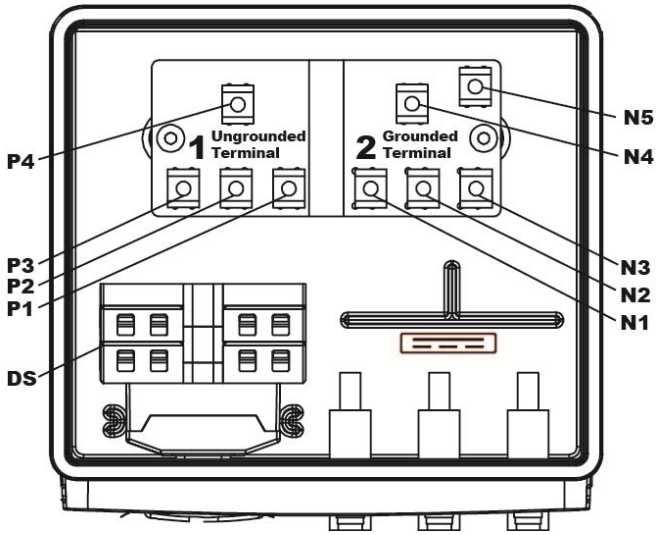
4.3.4.3. Stringbox Configurations

The Stringbox is equipped with DC switch and SunClix connectors.



P1, P2, P3:
Positive connectors
N1, N2, N3:
Negative connectors

Figure 4.3.8: DC connectors and DC switch



P1, **P2**, **P3:**
Terminals labeled *1.Ungrounded*
N1, **N2**, **N3:**
Terminals labeled *2.Grounded*

N4: Grounded terminal
N5: Terminal for the grounding strap
P4: Ungrounded terminal

DS: DC Switch

Figure 4.3.9: Stringbox with DC switch and DC connections

Negative Grounded PV String

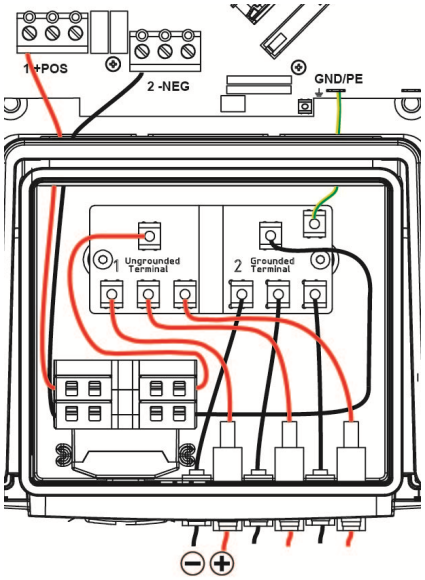


Figure 4.3.10: Negative grounded PV string

- The inverter is delivered from the factory in an ***ungrounded PV string configuration*** as standard.
- Connect the grounding strap between ***N5*** (*fig. 4.3.9*) and the ***DC ground receptacle*** *labeled* ***GND/PE*** in the inverter lower compartment.

Positive Grounded PV String

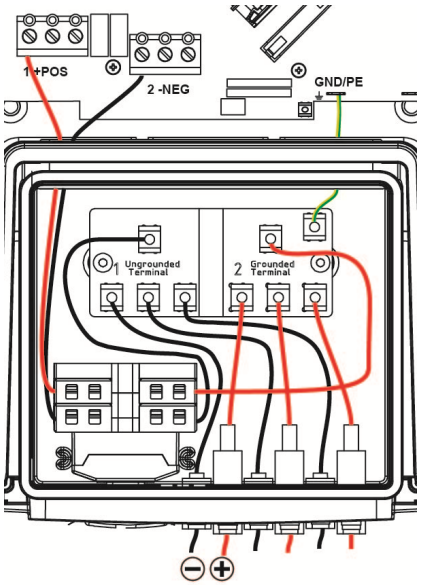


Figure 4.3.11: Positive grounded PV string

- Connect the **positive conductors (+)** to the terminals labeled ***2.Grounded***, and the **negative conductors (-)** to the terminals labeled ***1.Ungrounded***.
- Switch the conductors connected to ***N4*** and ***P4*** (*fig. 4.3.9*).
- Connect the grounding strap between ***N5*** (*fig. 4.3.9*) and the ***DC ground receptacle*** *labeled* ***GND/PE*** in inverter lower compartment.

4.3.4.4. Connection Procedures

- The DC conductors connecting the PV array to the inverter must each have a minimum rating of 600 V_{DC} at any operating temperatures.
- The DC conductor cables must be sized for correct temperature rating and sunlight resistance. Use copper wire with a cross-section area of between 6 mm^2 to16 mm^2 / 10 AWG to 6 AWG and temperature rating 90° C /194° F for all connections. Ensure compliance with the relevant national electrical regulations!

- Conductor insulation rating must be higher where the backs of the modules cannot receive cooling or where the ambient temperature exceeds 40° C. Note the relevant national electrical regulations!
- Follow the safety instructions and specifications from the module manufacturers regarding installation.

String Connectors

- The corresponding mating connectors must be provided by the system installer.
- Follow the guidelines from the connector manufacturer when choosing cable sizes and assembling them in the connectors.
- Plug in the connectors and hand-tighten them to the corresponding connector on the inverter.
- Check if the contacts are firmly tightened by pulling them gently.
- Only valid for France: Removal of the connectors requires a special tool. Note the relevant national electrical regulations!

4.3.4.5. Reversed DC Connection

If the positive and negative conductors are connected to the wrong terminals, the inverter will not start up. The inverter is not damaged due to internal reverse blocking diodes, but high currents are generated in the conductors.

DANGER

Be aware of high currents! If the DC terminals are mixed up during connection, high currents are generated in the conductors, which can pose shock hazards.

Procedure

- Turn OFF the DC switch(es) and the AC circuit breaker(s).

DANGER

The PV conductors are still charged after the DC switch in the Stringbox is turned OFF, due to power fed from the PV modules. Always turn OFF the remote DC switch and wait until the PV modules do not feed power.

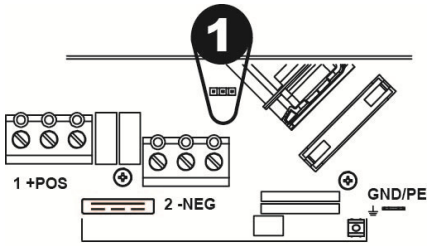
- Remove the PV connectors.
- Check with a voltmeter if the terminals are discharged.
- Disconnect the conductors from the terminal block.
- Connect the conductors to the correct terminal block.
- Test the polarity using a voltmeter before turning ON the DC switch(es) and the AC circuit breaker(s).

4.3.4.6. Jumper Position for the System Grounding Setup

The jumper above the - *NEG* terminal in the customer connection area monitors the arrangement of the DC connection according to the system grounding setup. When delivered, the jumper is positioned in an **ungrounded string configuration** as standard. Depending on the grounding requirements from the module manufacturer the jumper must be pulled up and positioned correctly to match the required grounding of the PV strings.

In case of a mismatch in grounding setup the following message will appear in the display "*Fuse fault*". Refer to *7.2. Table of Events*.

Table 4.1: Position for the jumper monitoring the grounding setup

Connection Area	Topview	System
 *1. Jumper for the grounding setup*		**Ungrounded PV String Configuration:** There is no connection between the pins.
		**Positive grounded PV String Configuration:** The jumper connects the two leftmost pins.
		**Negative grounded PV String Configuration:** The jumper connects the two rightmost pins.

4.3.5. AC Connections (Grid)

The AC connection includes wiring from the AC distribution panel through one or more circuit breakers to the AC terminal block of the inverter.

Verify that the AC grid specifications are compatible with the inverter characteristics before connecting the inverter to the AC grid:

- Single phase/Split phase
- Voltage range (184 – 276 V)
- Frequency range (50 Hz ±5 Hz)

CAUTION

The AC output / Neutral of the inverter is not bonded to ground.

DANGER

Turn OFF the AC circuit breaker(s) before connecting the inverter to the utility grid to prevent electrocution.

The *DLX* series are single phase output inverters, which are designed so that they can be connected to a three-phase system. When several inverters are connected together, they must be distributed evenly between the grid phases.

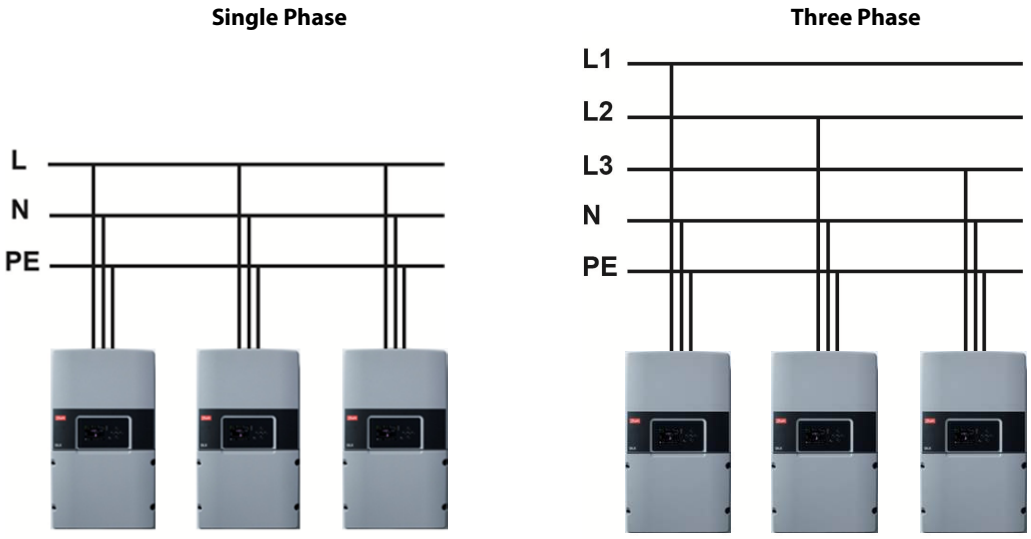


Figure 4.3.27: Example inverter AC connections

Table 4.2: The different AC conductors

Term (Abbr.)	Description
Phase conductor (*L1/L2/L3*)	The ungrounded live conductors, which carry current to the load.
Neutral conductor (*N*)	In a single phase system the neutral conductor is a circuit conductor carrying the same amount of current as the ungrounded phase conductors.
PE (Protective Earth / Ground) conductor	An electrical path to true Earth, designed to carry fault currents caused by insulation breakdowns within the equipment.

4.3.5.1. Connection Procedures

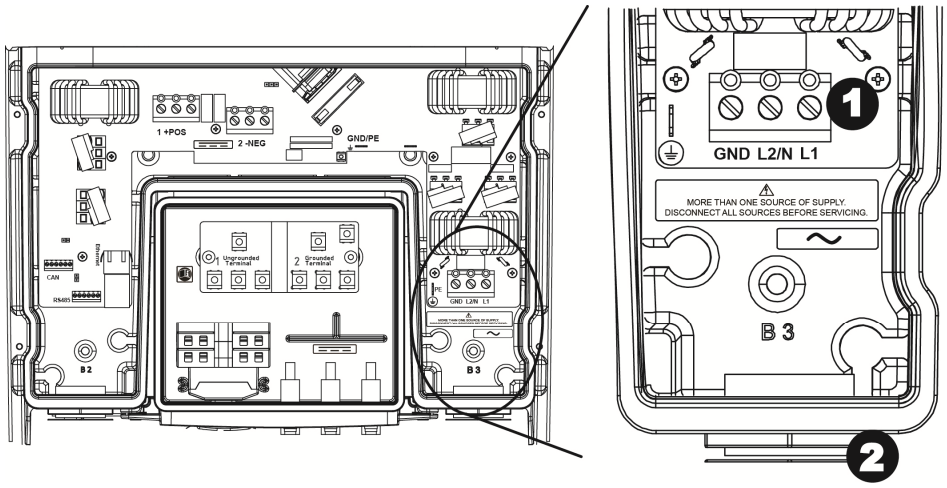


Figure 4.3.28: Customer connection area with AC terminals

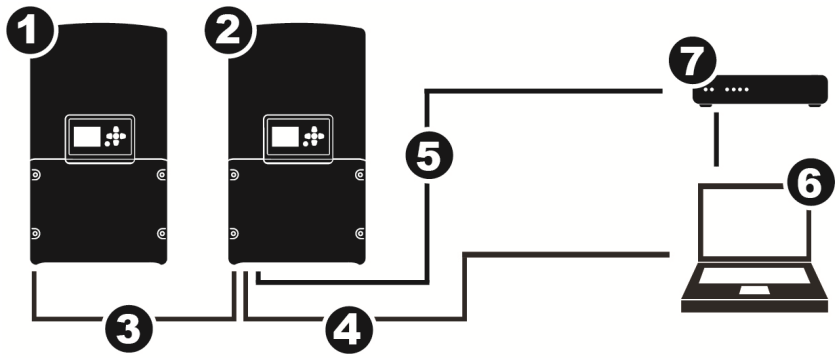
1. AC terminal block: ***GND****:* Ground terminal
N: Neutral terminal (TN/TT)
or Phase terminal (IT)
L: Phase terminal

2. Cable gland

- The current carrying conductors on the AC side must be rated for the current and have a cross section area of maximum 16 mm^2 / 6 AWG. Ensure compliance with the relevant local and national electrical regulations!
- The AC conductor resistance should be minimized by selecting as large a size of cable cross-section area as possible, up to 16 mm^2 / 6 AWG.
- Unscrew the cable gland locknut.
- Guide the AC cable through the opening, and connect the conductors to the corresponding terminals in the connection area:
  - **Phase** conductor (L1 or L2 or L3) to ***L***
  - **Neutral** conductor (TN/TT) or **Phase** conductor (IT) to ***N***
  - **Grounded** conductor to ***GND***
- Tightening torque of the terminals is 1.5 Nm
- Double check if the connection is correctly carried out.
- Hand-tighten the gland locknuts to seal the cable gland.

4.3.6. Network Connections

The inverter is equipped with three communication interfaces: Ethernet, CAN, and RS-485. **Ethernet** provides communication between the integrated web server and a computer, either directly or via a router/switch. **CAN** allows communication between several DLX inverters. **RS-485** allows communication with Danfoss comlynx compliant products.



1. Follower inverter
2. Master inverter
3. CAN bus cable
4. Ethernet cable
5. RS-485 cable
6. Computer
7. Data logger

Figure 4.3.29:Connection without network

4.3.6.1. Connection Procedures

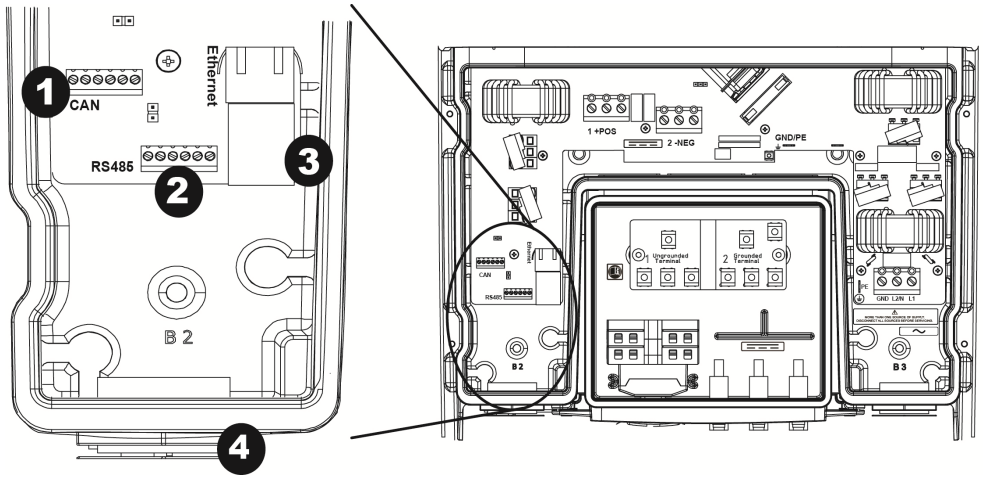


Figure 4.3.30: Customer connection area with network terminals

1. CAN bus terminal
2. RS-485 terminal
3. Ethernet connector
4. Network cable gland

- **Ethernet:** Use CAT5e or better, with size 0.21 mm^2 /24 AWG, and a maximum total length of 100 m.
- **CAN:** Use CAT5e or better, with size 0.21 mm^2 /24 AWG, with a maximum total length of 500 m.
- **RS-485** Use CAT5e or better, with size 0.21 mm^2 /24 AWG, with a maximum total length of 1200 m

- Unscrew the network cable gland, and take out the grommet.
- Three-way cable gland insert:

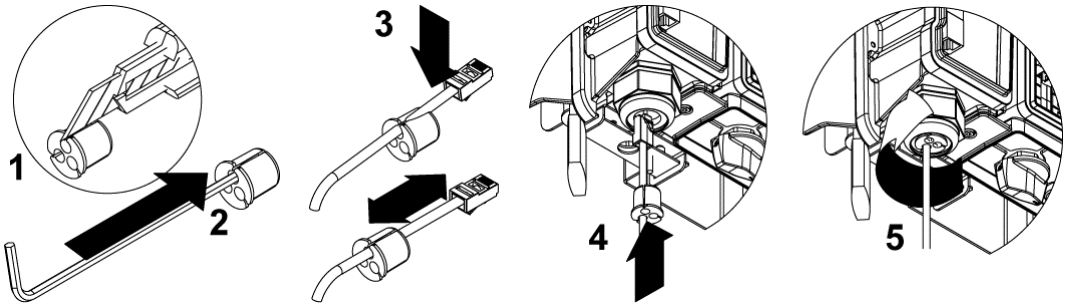


Figure 4.3.31: Insertion of network cables in gland

1. Conductors with connector: Cut through the grommet with a width of about 1mm. With no connector no cutting is necessary
2. Remove the plug from inside the grommet.
3. Assemble the cable in the gap.
Repeat step 1 – 3 if more cables.
4. Guide the assembly into the cable gland.
5. Connect the cables to the terminals in the connection area as follows:

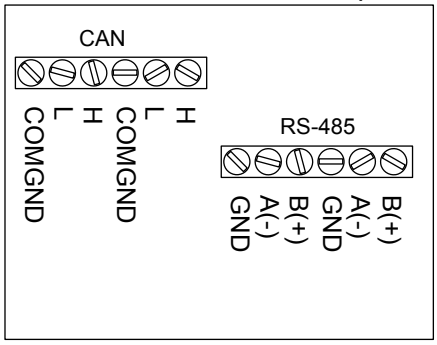
- **Ethernet:** Plug the Ethernet cable directly in its port.
- **CAN:** The conductors must be connected to the same labeled terminals at both ends: i.e. ***H***, ***L*** to ***L*** etc. Recommended tightening torque is 0.2 Nm
- **RS-485:** The conductors must be connected to the same labeled terminals at both ends: i.e. ***A*** connected to ***A***, ***B*** to ***B*** etc. Recommended tightening torque is 0.2 Nm.

6. Tighten the cable gland firmly.

NOTICE

Cable shielding: It is recommended to mount the cable shielding for both the CAN and RS-485 with the GND at the receivers end.
If any kind of datalogger is connected to an inverter, then only mount the shield at the datalogger.
If the system consists of two or more inverters, then only mount the shield at the "Master"

CAN and RS-485 connection pinout

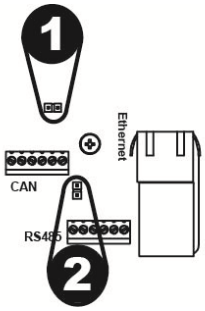


4.3.6.2. Jumper Position for Termination Resistance

With several inverters connected, the jumper located behind the CAN / RS-485 terminal activates the termination resistance when the pins are terminated (short-circuited). This minimizes signal reflections in the cables and helps to avoid interference.

- **Single inverter:** The two pins can be terminated or disconnected).
- **Several inverters connected**: The master-follower configuration requires terminated pins on the first inverter and on the last inverter in the linked series. The pins must be disconnected on the inverters between the first and last inverters in the linked series.
- To disconnect the pins, the jumper must be pulled up and placed only on one of the pins.
- Be careful not to bend the pins when removing or installing the jumper!

Table 4.3: Position of the jumper for the termination resistance

Network connection	Jumper Position	Pins
		The pins are terminated.
		The pins are disconnected.

1. *CAN termination resistance*
2. *RS-485 termination resistance*

4.3.7. Checks before Start Up

☑ **Mounting:**
- Check that the bracket and the inverter are correctly mounted and secured.

☑ **PV wiring:**
- Check that the PV cables are rated for the PV current and for the expected environmental conditions.
- Check that the wiring is performed according to local and national electrical regulations.

☑ **Connection:**
- Check that the PV conductors are correctly torqued to the DC terminals.
- Check that all connectors and cable glands are correctly tightened and sealed.

☑ **DC side:**
- Verify that the PV open-circuit voltage, V_{OC}, **does not exceed** 600 V_{DC}
- Check that the DC polarity is correct.

☑ **AC side:**
- Verify that the AC conductors on are correctly connected to the AC terminals.

☑ **Grounded conductors:**
- Check that the grounded conductors are properly sized, and **not** fused or switched.

☑ **Jumpers:**
- Check that the jumpers for the grounding setup and for the termination resistance are correctly positioned according to the grounding setup.

☑ **Disconnects:**
- Ensure that all current-carrying conductors on both the DC and AC side can be disconnected, and that the disconnects are located correctly and are readily accessible.

☑ **Overcurrent protection:**
- Ensure that the overcurrent protection on both the DC and the AC side are rated correctly, and capable of being changed without touching live contacts.

☑ **Inverter cover:**
- Ensure that no cables interfere with the sealing of the inverter lower cover, and fasten the cover firmly to the housing. Recommended tightening torque is 1.0 Nm / 0.74 ft-lbf.

CAUTION

Verify that the lower cover is correctly secured so no moisture enters the housing and damages the electronic components.

5. START UP

This chapter provides instructions to ensure a safe start- up of the DLX inverters. The start-up of the inverter requires the presence of AC and DC voltages. Do not attempt to start up or commissioning the inverter if one of the voltage sources is not available.

5.1. How to Start Up

A minimum available voltage of **184 V_{AC}**, **230 V_{DC}** and a DC power greater than **7 W_{DC}** is required before the inverter starts-up and begins feeding power to the grid.

AC Side

- Turn ON the AC circuit breaker(s).

DC Side

- Turn ON the DC switch(es).

5.2. Initial Start

When the inverter is started for the first time, with minimum available voltages of **184 V_{AC}**, **230 V_{DC}** and a DC power greater than **7 W_{DC}**, an installation menu is automatically displayed to enable the configuration of certain critical values and operational settings.

5.2.1. Customizing the Inverter Settings

Single Inverter

- When both the AC circuit breaker and the DC switch are turned **ON** and the inverter is supplied with enough power, the installation menu is displayed on the LCD screen.

Multiple Inverters Connected

1. CAN

- Connecting all inverters via the CAN bus enables the configuration of all inverters in a plant via one inverter. The *Start Up* can then be carried out on any inverter, and if configured as the *master* inverter the configuration settings of *time*, *date*, *language* and *grid settings* will be transferred to all the other follower inverters on the network.
- Each inverter is automatically assigned an ID number from the *master* during *Start Up*.

NOTICE

If multiple inverters are connected together, all inverters must be connected to the CAN bus, and receiving sufficient AC and DC power, before *Start Up* to benefit from single installation setup.

2. RS-485

- Connecting all inverters via the RS-485 bus enables communication Danfoss comlynx compliant products.
- Each inverter must be assigned an ID number, a bit rate number and a parity number manually:

  - The ID number must be between 1 and 247.
  - Both the *master* inverter and the *follower* inverters need a bitrate number and a parity number. Compare with the setup in the third party equipment (eg. an external data logger) and write these numbers in the inverter's network menu. Refer to section *6.2.4.2. Network Setup* for further details.
    Default is bitrate: *19200* and parity: *none*.

- The RS-485 is compliant with the Danfoss Comlynx protocol.

5.2.2. User Interface

The *User Interface* on the front of the inverter contains a LCD screen, three LEDs and six function keys.

LCD Screen

To navigate in the LCD screen the six function keys must be used. By selecting one of the seven items in the *Main Menu,* a further navigation through different submenus is possible. There are four different menu levels.

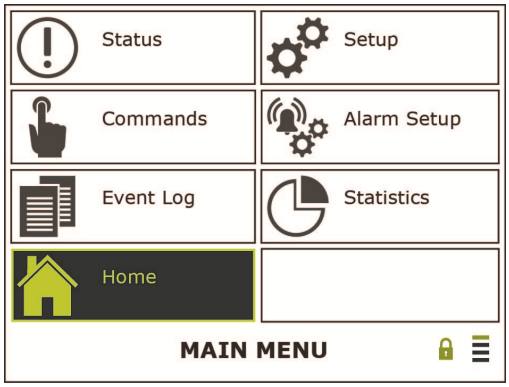


Figure 0.1: LCD screen interface

Home*, *Status*, *Event Log, Statistics:
The information and values are read-only.

Setup*, *Commands, Alarm Setup:
The information and values can be modified.

Padlock: Opens up when correct password is entered.

Lines: Number of highlighted lines indicates the current menu/submenu level, with the top line being the first level (*Main Menu*).

- To activate the display when the screen saver is active (blank), press any key.

LEDs

There are three LEDs next to the display screen. The upper one is red, the middle is yellow and the lower one is green.

Table 0.1: LEDs.

Symbol	LED	Function	Action
	**Red**	Malfunction! Inverter in shutdown mode	Look for alarms in *Active Alarms*
 	**Green & Yellow**	Caution! Inverter still operates, but at a limited level	Look for warnings in *Active Alarms*
	**Green**	Operates; inverter feeds power to the grid	No action
NONE	**Yellow**	Inverter is OFF (Power < $7W_{DC}$)	No action

5.2.3. Function Keys

The function keys have the following uses:

Table 5.1: Function keys

Symbol	Function	Symbol	Function
	***Up*:** Scroll up / increase value		***Right:*** Navigate one page or value right
	***Down:*** Scroll down / decrease value		***Enter:*** Select option / go to next level
	***Left:*** Navigate one page or value left		***Cancel:*** Stop operation / back to previous menu item

- The selected item is always highlighted in yellow.
- A registered touch of a button causes a "*click*" sound to be heard.

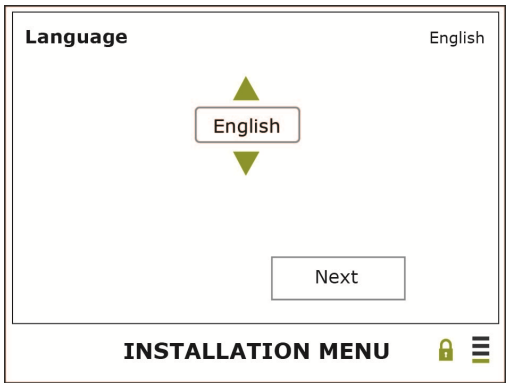
5.2.4. Software Installation

At first power-up, and with sufficient AC power, the display shows the *Start Installation* screen.

1. Start

Left – Cancel
Right –Ok
Enter **–** Confirm

2. Language

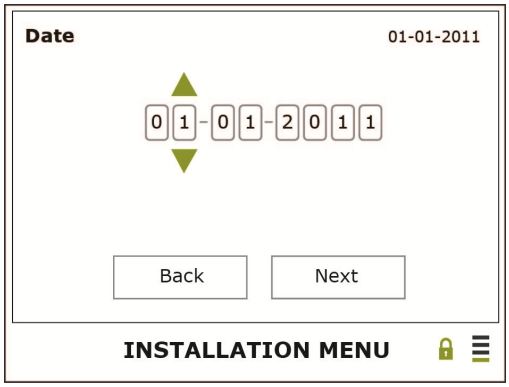


Default – English

Enter – Call up the list of languages
Up or ***Down*** – Navigate through the list to find the preferred language: *English*, *German*, *Spanish*, *French*, *Italian, etc.*.
Enter – Confirm

Right – Next
Enter – Confirm

3. Date

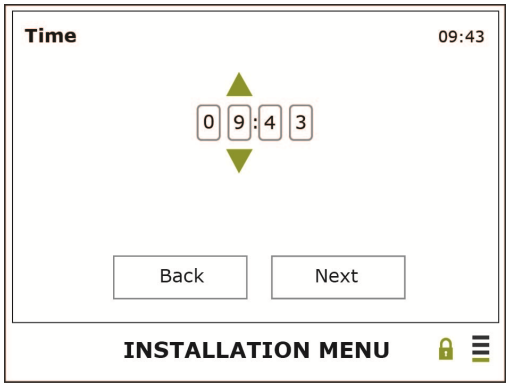


DD.MM.YYYY

Enter – Call up the date
Up – Increase present digit
Down – Decrease present digit
Right – Select next digit
Left – Select previous digit
Enter – Confirm

Left – Back
Right – Next
Enter – Confirm

4. Time



HH.MM (24 H)

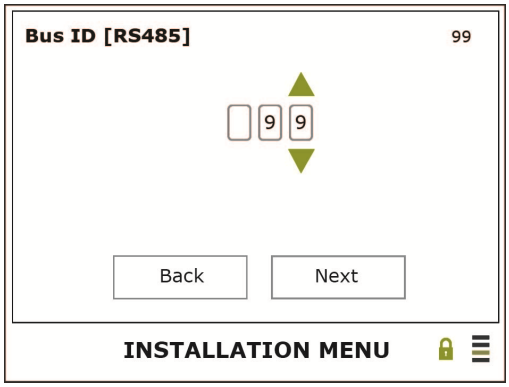
Enter – Call up the time
Up – Increase present digit
Down – Decrease present digit
Right – Select next digit
Left – Select previous digit
Enter – Confirm

Left – Back
Right – Next
Enter – Confirm

NOTICE

The time setting must match the time on the actual installation site, otherwise data may be overwritten!

5. Set Bus ID

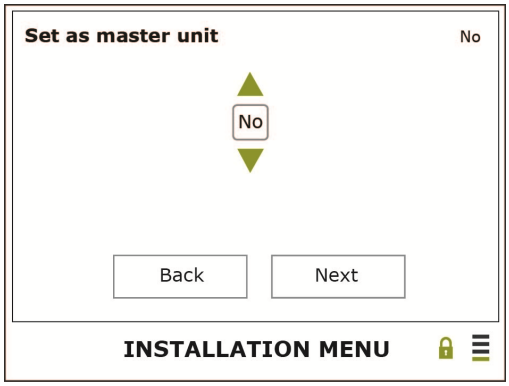


Enter – Call up the digits
Up – Increase present digit
Down – *Dec*rease present digit
Enter – Confirm

Left – Back
Right – Next
Enter – Confirm

If RS485 communication is used, set a unique bus ID for the inverter. For any client inverters, this will be required to be set manually under ***Setup > Network Setup > Bus ID (RS485)***. If RS485 communication is not used, this step can be missed.

5. Set as Master Unit

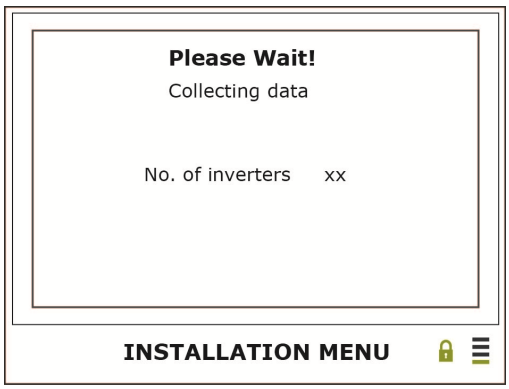


Default – No

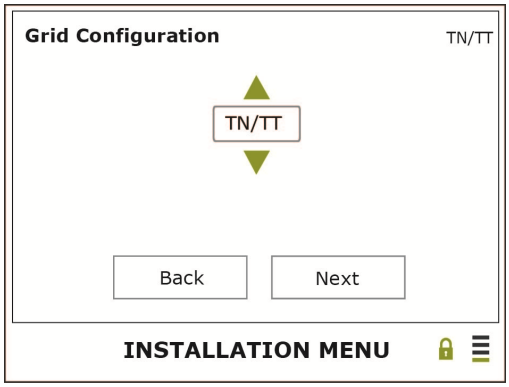
Enter – Call up the options: Yes or No
Up – Yes
Down – No
Enter – Confirm

Left – Back
Right – Next
Enter – Confirm

If the inverter is set to master, data must be collected from the follower inverters. The following screen is displayed:



7. Grid Configuration

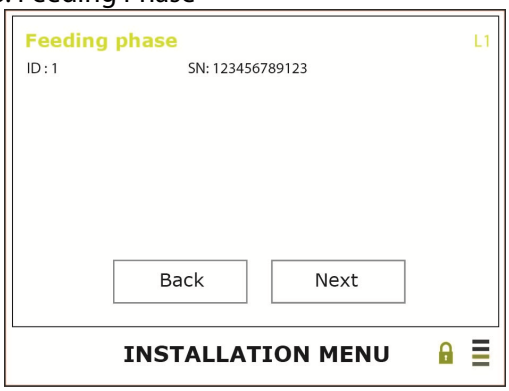


Enter – Call up the list of grid configurations
Up or ***Down*** – Select the grid configuration of the actual installation site:
TN/TT, *IT*, *Undefined*

Enter – Confirm

Left – Back
Right – Next
Enter – Confirm

8. Feeding Phase



Enter – Call up the list of phases

Up or ***Down*** – Select the preferred phase:
- If configured for **TN/TT**: *Not set*, *L1*, *L2*, *L3*
- If configured for **IT**: *Not set*, *L1-L2*, *L1-L3*, *L2-L3*

Enter – Confirm

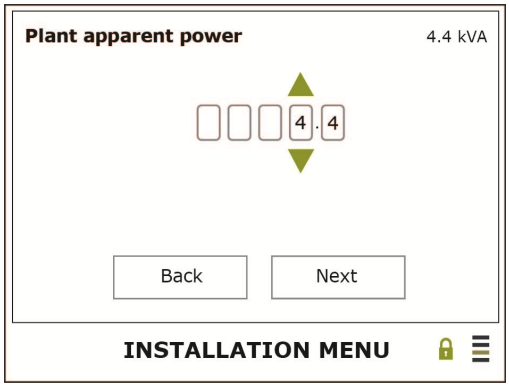
Left – Back
Right – Next
Enter – Confirm

If the inverter is set to master, and there is more than one inverter in the plant, the following screen is displayed:

If the inverter is configured as master: step through and set the feeding phase (L1, L2, L3, L1-L2, L1-L3, or L2-L3 as required) for all follower inverters.

9. Plant Apparent Power

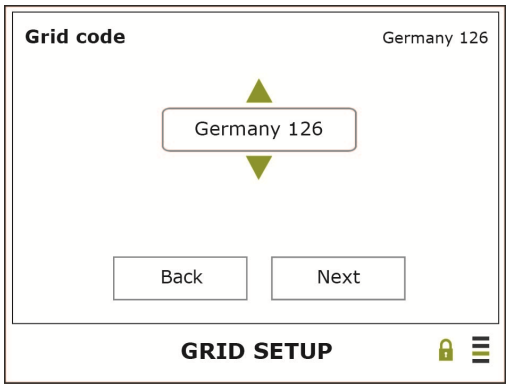
Plant apparent power is used to determining certain *VDE 4105* default settings. The value shown in the installation menu is a suggestion and must be confirmed. Please call up the digits and change values if required before pressing Enter.



Enter – Call up the digits
Up – Increase present digit
Down – Decrease present digit
Enter – Confirm

Left – Back
Right – Next
Enter – Confirm

10. Grid Code



Enter – Call up the list of grid codes
Up or ***Down*** – Scroll through the list to select the required grid code for the actual installation site:
Enter – Confirm

Left – Back
Right – Next
Enter – Confirm

CAUTION

The selected grid code must match the actual installation site; otherwise the inverter may not operate or be compliant to relevant local and national regulations due to incorrect limit values.

NOTICE

- **UK:** Follow the local electrical regulations when selecting the grid code setting; either normal grid code setting or *UK 16A Limit* restricted grid code setting with a 16A limitation for G83 compliance.
- **Germany:** Follow the local electrical regulations when selecting the grid code setting; either *Germany 126* (VDE 0126-1-1) or *Germany 4105 (VDE-AR-N 4105)*.

The following screen is displayed while inverter settings are being updated:

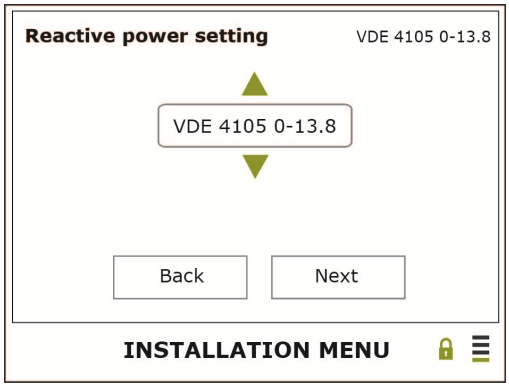
Grid Code Selection

NOTICE

An installation timer ensures that the grid settings can be changed (using the *Owner* password) within **5 hours** of feeding power to the grid. Thereafter it is only accessible using the *Installer* password, which may only be obtained for installers and grid operators by contacting *Danfoss*.

This step shows the configured Reactive Power Setting. If the setting is incorrect, press Enter to call up the options and select the correct standard.

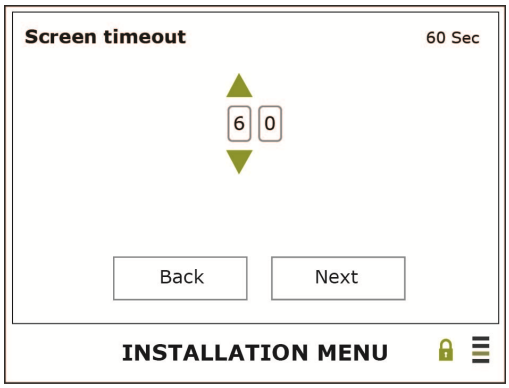
11. Reactive Power Setting



Enter – Call up the options
Select the Reactive power setting:
1. For installations less than 13.8 kVA:
VDE 4105 0 – 13.8
2. For installations greater than 13.8 kVA:
VDE 4105 13.8 –
Enter – Confirm

Left – Back
Right – Next
Enter – Confirm

12. Screen Timeout



Enter – Call up the digits
Default – Screen backlight OFF after 60 sec

Left – Back
Right – Next
Enter – Confirm

NOTICE

The smallest value to be set is **30 sec**, and the highest is **99 sec**.
Setting the value to **0** disables the screen timeout and leaves the screen backlight ON at all times.

13. Customer Name

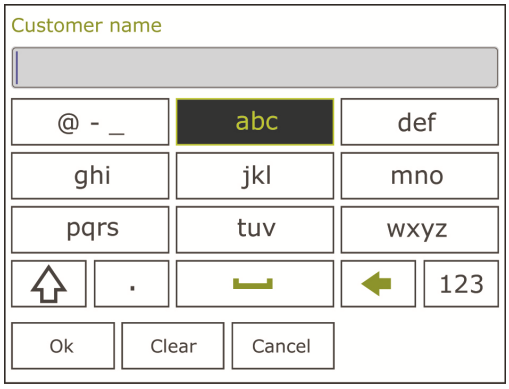
Enter – Call up the keyboard

The keyboard enables the typing of a customer name.

Left – Back
Right – Next
Enter – Confirm

In some of the submenus the settings must be typed by using the function keys:

Letter keyboard



Number keyboard

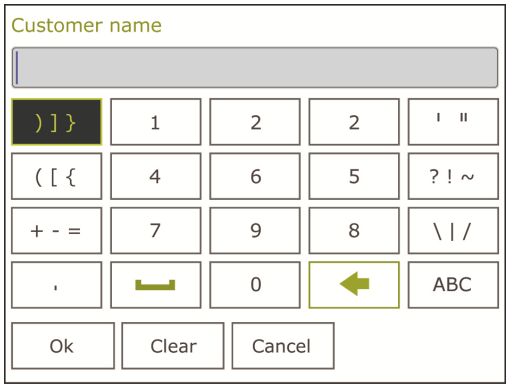


Table 5.2: Symbols appearing in the type screens

Symbol	Description	Symbol	Description
	Upper- or lower-case letter	Ok	Confirm changes and exit the menu
	Point	Clear	Clear the typing field
	Space	Cancel	Go back without saving changes
	Cancel last letter	ABC	Go to the Letter keyboard
		123	Go to the Number keyboard

- *Enter* must be pressed until the wanted letter/number/symbol is shown.
- It is possible to navigate between the characters by using the *Up* arrow to set the marker into the text window, then using *Left* and *Right* to navigate between the characters.
- There is space for a maximum of 19 characters in the text window.

14. Site

Enter – Call up the keyboard

The keyboard enables the typing of a site name.

Left – Back
Right – Next
Enter – Confirm

15. Unit Name

Enter – Call up the keyboard

The unit name helps to distinguish and identify specific inverters in a larger PV plant.

Left – Back
Right – Next
Enter – Confirm

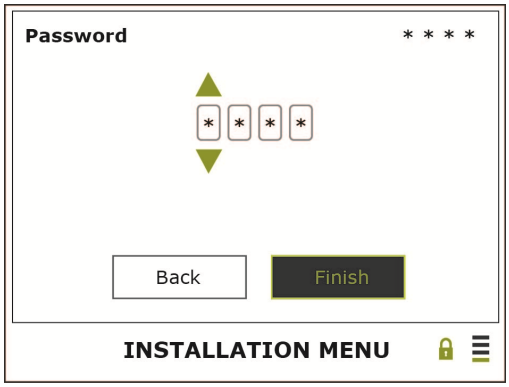
16. Message

Enter – Call up the keyboard

This message field is to help distinguish and identify specific inverters in a larger PV plant, or for any other information.

Left – Back
Right – Next
Enter – Confirm

17. Owner Password



Enter – Call up the digits
Default: 0003.
Change the password to 4 optional digits

Left – Back
Right – Finish
Enter – Confirm

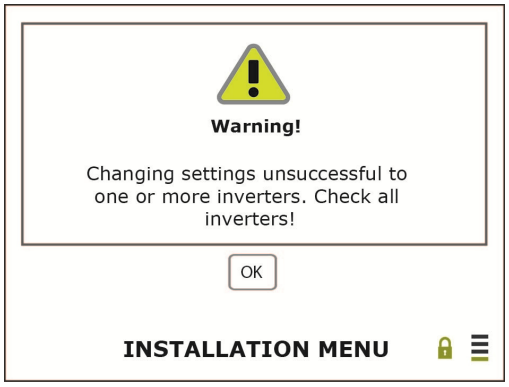
NOTICE

With several inverters connected it must be checked that the installation is carried out on all the follower inverters.

- Look at the displayed menu and the LEDs: It is **not** carried out correctly if the installation menu is still displayed and/or the green LED is **not** lit and the yellow and red LEDs are lit.
- Check that the connection of the CAN cables are correct, that the AC and DC switches are ON and that the voltages are **>184 V_{AC}**, and **>230 V_{DC}** and there is greater than **7 W_{DC}** of power
- If the *Start Up* phase is correctly carried out the inverters are ready to use. They are fully automatic during normal operation, and no manual control is necessary for feeding power into the grid.

The 'Warning' box is displayed if an error occurred during installation:

Warning Box



Errors:
1. No communication
2. Wrong grid settings

- Check the LEDs on the inverters. If the yellow and reds are lit check that the installation is correctly performed and that the grid settings are correctly set.
- If the *Start Installation* - screen is still shown, run through the installation process on the inverter.

5.3. Self Test for Italy

The *Self Test* function is only valid for Italy. It tests the inverters' grid monitoring function of voltage and frequency. The inverter carries out four test sequences, which together takes approximately 2 minutes.

The self-test changes the trip values for the voltage and frequency to the current grid levels to determine:

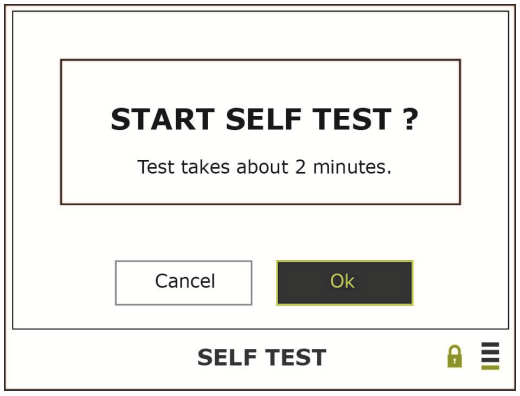
- Whether the threshold equals the actual measured grid values.
- Whether the inverter is triggered to disconnect from the grid by these limits.

5.3.1. Start

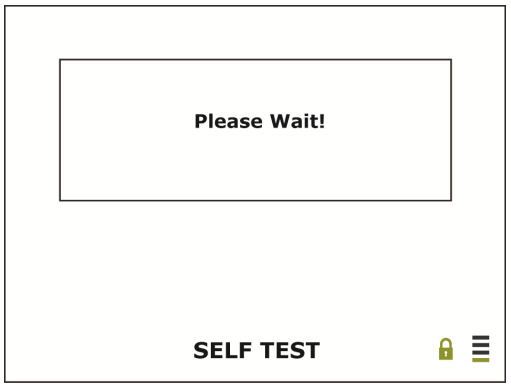
The *Self Test* can only be activated when:

- The installation procedure is executed
- The country configuration is set to *Italy*
- The inverter is in *Running/Derating Mode* (i.e. sufficient irradiation).

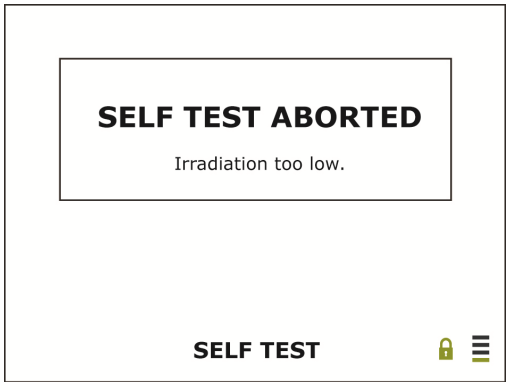
Select: *Commands* > *Inverter Commands* > *Self Test*



Left – Cancel
Right – Ok
Enter – Confirm



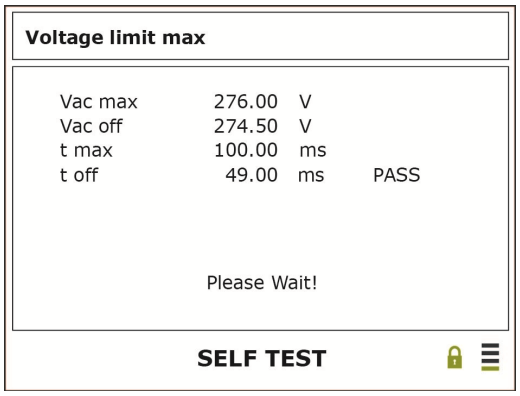
The test needs some seconds to start.



The test can fail if the irradiation is insufficient, as the inverter is unable to feed power to the grid. Restart the test later.

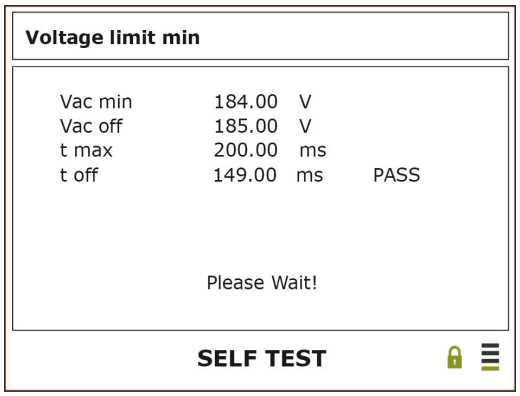
5.3.2. Voltage Monitoring

First, the overvoltage monitoring is checked. The voltage trip level is ramped down from the maximum allowed voltage level, 276 V_{AC}, and decreased until it equals the current grid voltage. The time it takes from equalization of the voltage to when the inverter disconnects from the grid is measured.



$V_{AC\,max}$	Maximum allowed voltage; trip level
$V_{AC\,off}$	Disconnection voltage level; equalization
t_{max}	Maximum allowed disconnection time
t_{off}	Time from equalization to disconnection
PASS	The first sequence is successfully carried out
FAIL	The first sequence has failed – try again later

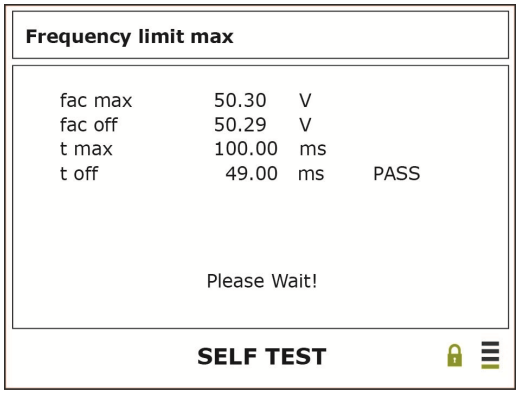
Second, the undervoltage monitoring is checked. The trip level is ramped up from the minimum allowed voltage level, 184 V_{AC}, and increased until it equals the current grid voltage. The time it takes from equalization to disconnection is measured.



$V_{AC\,min}$	Minimum allowed voltage; trip level
$V_{AC\,off}$	Grid voltage level
t_{max}	Maximum allowed disconnection time
t_{off}	Time from equalization to disconnection
PASS	The second sequence is successfully carried out
FAIL	The second sequence has failed – try again later

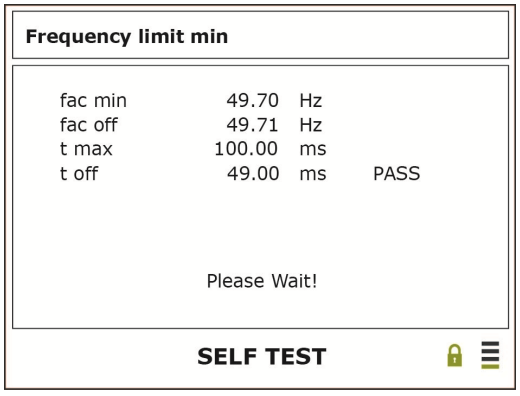
5.3.3. Frequency Monitoring

The inverter repeats the test sequence, but now with the frequency trip limits. First, the upper frequency trip level is ramped down from the maximum allowed frequency level, and decreased until it equals the current grid frequency. The time it takes from equalization to disconnection is measured.



$f_{AC\,max}$	Maximum allowed frequency; trip level
$f_{AC\,off}$	Disconnection frequency level; equalization
t_{max}	Maximum allowed disconnection time
t_{off}	Time from equalization to disconnection
PASS	The third sequence is successfully carried out
FAIL	The third sequence has failed – try again later

Second, the under frequency monitoring is checked. The trip level is ramped up from the minimum allowed frequency level, and increased until it equals the current grid frequency. The time it takes from equalization to disconnection is measured.

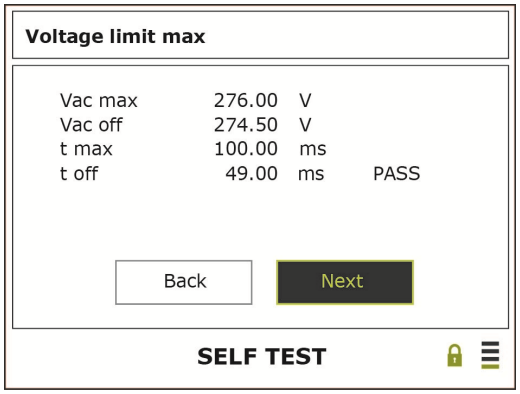


$f_{AC\,min}$	Minimum allowed frequency; trip level
$f_{AC\,off}$	Disconnection frequency level; equalization
t_{max}	Maximum allowed disconnection time
t_{off}	Time from equalization to disconnection
PASS	The fourth sequence is successfully carried out
FAIL	The fourth sequence has failed – try again later

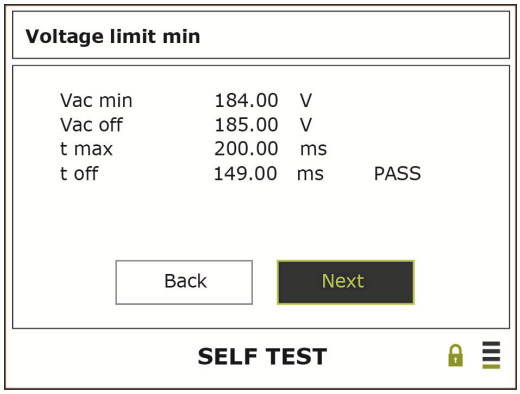
5.3.4. Finish

After the test is successfully finalized, the test results are displayed.
Enter *Next* to confirm each result, and enter *Finish* on the last result to finalize the test.

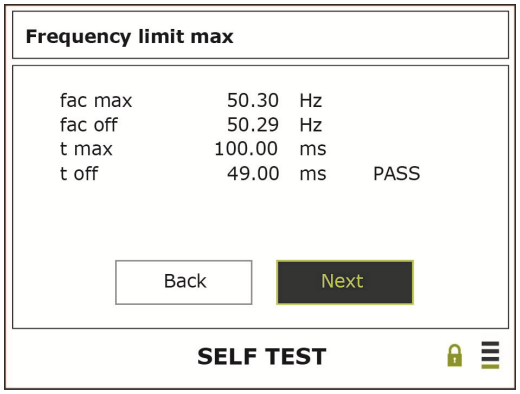
1.



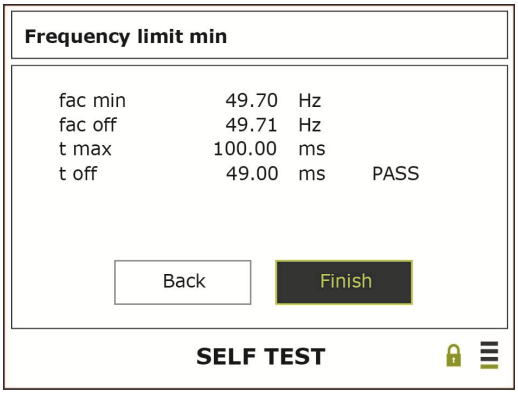
2.



3.



4.



- After successfully finalization of the test, the inverter goes back to the *Inverter Command* menu.
- The test results are stored in *Commands* > *Inverter Commands* > *Results Self Test.*
- If the test fails more than **3** times, contact *Danfoss*.

6. OPERATION

This chapter describes how to operate the inverter via the LCD display with the function keys, or with a PC connected to the embedded webserver.

Please refer to 5.2.2. for a description of the LCD Screen and the meanings of the colored LEDs

6.1. Access Levels and Passwords

There are three access levels to the different submenus:

Password	Access
Guest	Read all values.
Owner	Read all values and set all values except installer related values. Default *Owner* password is **0003**, but can be changed in *Setup>General Setup>Password*. If the password is lost or forgotten, contact *Danfoss*.
Installer	Read and set all values. The *Installer* password is based on the serial number, and can only be obtained by contacting *Danfoss*.

NOTICE

Any change of setting needs a password. Once the password has been entered, modifications must be done within **1 minute** before the access resets to *Guest* level.

6.2. LCD Screen Menus

To navigate in the LCD screen the six function keys must be used. By selecting one of the seven items in the Main Menu, a further navigation through different submenus is possible. There are four different menu levels.

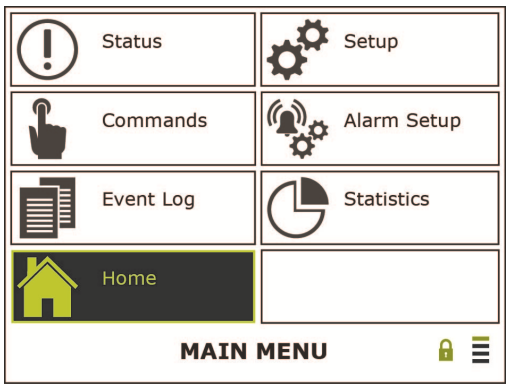


Figure 0.1: LCD screen interface

Home*, *Status*, *Event Log, Statistics:
The information and values are read-only.

Setup*, *Commands, Alarm Setup:
The information and values can be modified.

Padlock: Opens up when correct password is entered.

Lines: Number of highlighted lines indicates the current menu/submenu level, with the top line being the first level (*Main Menu*).

- To activate the display when the screen saver is active (blank), press any key.

6.1.2. Home

Home is the standard display, which is always shown if no buttons are touched within the screen timeout – interval, which is set during installation. (min 30 sec, max 90 sec).
If the unit is set as *master*, the default menu contains status/mode information for the whole plant.

Single Inverter

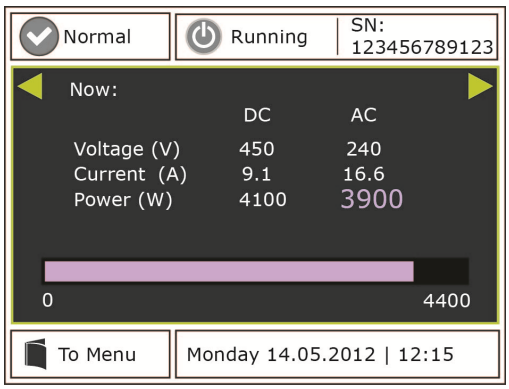


Figure 6.2.2: Standard display *Standard display for a single inverter*

Values of PV (DC) and feed-in (AC) current, voltage and power are shown numerically. The instantaneous output power is shown as a bar graph.

Plant

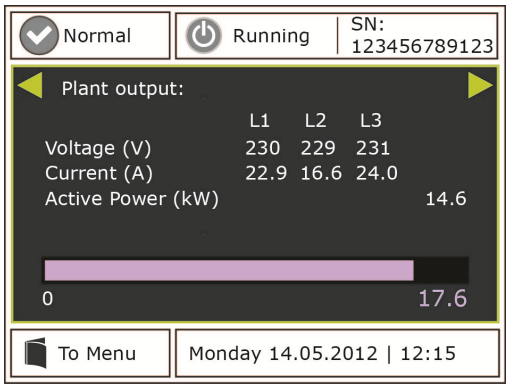


Figure 6.2.3: Standard displa for a larger PV plant y

Plant values of PV (DC) and feed-in (AC) current, voltage and active and apparent power for each phase are shown numerically. The instantaneous output power is shown as a bar graph.

Use the scroll keys and observe daily, monthly and yearly values:

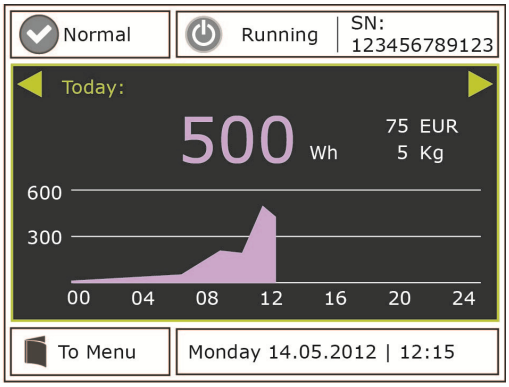


Figure 6.2.4: Energy harvest throughout the day

Up or ***Down*** – Navigate in the screen.
Left or ***Right*** – Observe the daily, monthly and total yearly values of :

- Energy harvest [Wh/kWh]
- Peak power [Wp]
- Earning [value of the respective country]
- Avoided CO_2 emission [kg].

6.1.2.1. Upper Display Area

The left section shows the status of the inverter. Refer to *Table 6.2* for the three different status options. It is also a shortcut to the *Active Alarms.*
The middle section shows the operation mode. Refer to *Table 6.3* for the eight different modes options.
The right section shows the serial number of the inverter, which is also to be found on the product label.

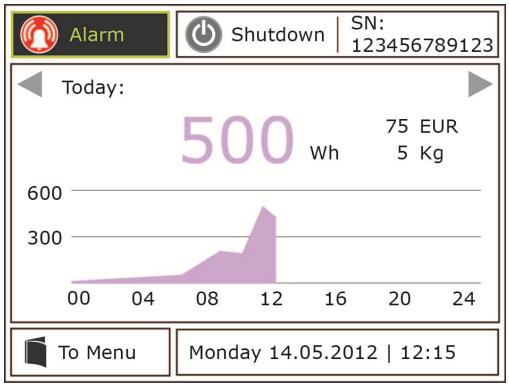


Figure 6.2.5: Upper display area of the home screen

Up or ***Down*** – Navigate in the screen.
Enter – Confirm

Table 6.2: Inverter status notifications

Sign	Status	LEDS
	Normal: inverter operates with no warnings or alarms	**Green**
	Warning: inverter still operates, but there is a warning	**Green&Yellow**
	Alarm: inverter in shutdown, there is an alarm	**Red**

Table 6.3: Inverter mode notifications

Sign	Mode	LEDs
	Off: Input power is not sufficient to start the power control circuitry	Yellow
	Sleeping: automatic shutdown. Input power is not sufficient to start up	Yellow
	Start-Up: initialization of input values and grid conditions	Green&Yellow
	Running: feeding power to the grid	Green
	De-rating: output power is reduced to protect the inverter against overheating	Green&Yellow
	Shutting Down: inverter in shutdown mode	Yellow
	Shutdown: inverter/system failure or unstable operational conditions	Red
	Service Mode: inverter can be manually overridden	Yellow

6.1.2.2. Lower Display Area

The lower section contains a shortcut to the *Main Menu* and shows the current date and time.

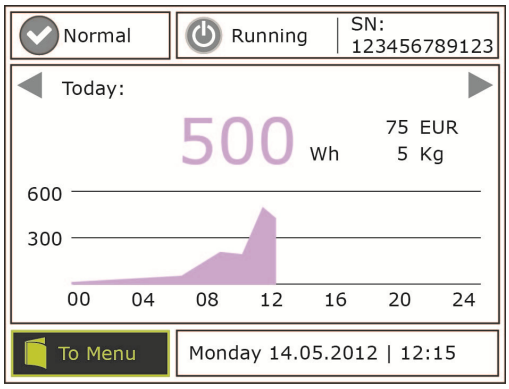


Figure 6.2.6: Lower display are of the home screen

Up or ***Down*** – Navigate in the screen.
Enter – Confirm

6.1.3. Status

Status displays the operating mode and status of the inverter and the PV plant. All the values are read-only.

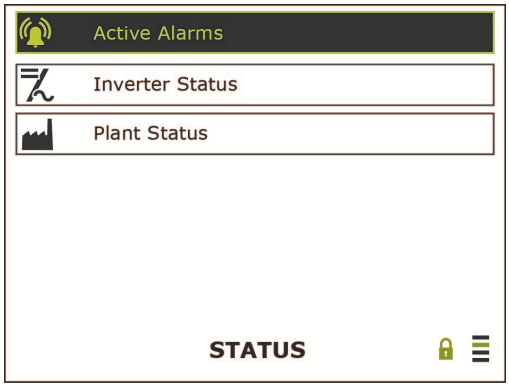


Figure 6.2.7: Submenus to Status

Up or ***Down*** – Navigate through the submenus/values
Enter – Select submenu/confirm

6.1.3.1. Active Alarms

Active Alarms displays detailed information about the current operating mode - and status signs appearing in the upper left corner of the *Home* screen. Refer also to *7.2. Table of Events*.

6.1.3.2. Inverter Status

Inverter Status displays the operating mode, status and operating parameters of the inverter.

Inverter Mode	The inverter has 8 different modes. Refer to *Table 6.3*
Inverter Error	The inverter has 3 different status levels. Refer to *Table 6.2*
Input Parameters	Current, voltage and power fed from the PV modules to the inverter
Output Parameters	Current, voltage, frequency and power fed from the inverter to the grid
Inverter Peak Power	Highest power achieved throughout the day
Energy produced today	Total energy harvest throughout the day
Temperature	Temperature inside the inverter
Isolation Resistance	Level for a safe insulation between DC - and AC side to prevent injury or equipment failure. The resistance must be minimum 600 kΩ
Operating Hours	Total inverter running time from *Start Up*
Apparent Power (VA)	The product of voltage and current from the inverter [VA]
Reactive Power (VAr)	Reactive power produced by the inverter [VAr]
Cos Phi	Ratio between active and apparent power from the inverter

6.1.3.3. Plant Status

Plant Status displays the operating mode, status and operating parameters of the plant.

Plant Mode	The plant has 8 different modes. Refer to *Table 6.3*
Plant Status (Error)	The plant has 3 different status levels. Refer to *Table 6.2*
Number of inverters	Total number of inverters in the plant
Number of active inverters	Number of active inverters in the plant
Number of inverter alarms	Event alarms in the plant
Number of inverter warnings	Event warnings in the plant
Input Current	Total current from the PV modules to the inverters
Input Power	Total power from the PV modules to the inverters
Output Current	Total feed-in current to the grid from all active inverters
Output Voltage	Total feed-in voltage to the grid from all active inverters

Output Power	Total feed-in power to the grid from all active inverters
Energy produced today	Total energy production throughout the day for the plant

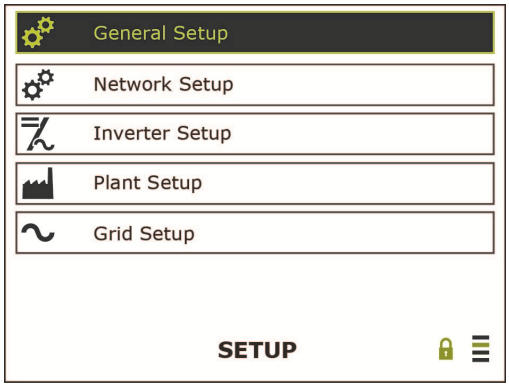
Phase Values

Phase Values displays the inverter's various feed-in parameters for the different grid phases.

Output current (L1)	Value of current fed into phase 1
Output voltage (L1)	Value of voltage fed into phase 1
Output power (L1)	Value of power fed into phase 1
Output current (L2)	Value of current fed into phase 2
Output voltage (L2)	Value of voltage fed into phase 2
Output power (L2)	Value of power fed into phase 2
Output current (L3)	Value of current fed into phase 3
Output voltage (L3)	Value of voltage fed into phase 3
Output power (L3)	Value of power fed into phase 3

6.1.4. Setup

Setup displays settings and data from the inverter, the grid and the PV plant.



Up or ***Down*** – Navigate through the submenus
Enter – Select submenu/confirm

Figure 6.2.8: Submenus to Setup

6.1.4.1. General Setup

General Setup displays some of the general parameters of the inverter, which can all be changed using the *Owner* password.

Language	The preferred language must be set during installation: English (default), German, Spanish, French, Italian
Date	Current date must be set during installation
Time	Current time must be set during installation
Password	*Owner* password must have 4 digits. Default is 0003
CO_2 Rate	Avoided CO_2 emissions, based on 0.7 kg/kWh
Earnings Rate	Feed-in tariff in the respective country
Earnings Currency	Valid currency in the respective country
Screen Timeout	ON time for the display backlight

Power Saving during night time	Power saving can either be ON or OFF during nighttime. Enabling this option turns the GUI off 15 minutes after the inverter enters OFF mode, ie. night time, to save power. Only applicable for *client* inverters

6.1.4.2. Network Setup

Network Setup displays the settings for the connected network, which can all be changed with the *Owner* password. Refer to *6.2. Connection between Inverter and Computer*.

NOTICE

All IP addresses related to the inverter and web must be configured with numbers!

Network IP-Address [Static/DHCP]	Unique network address for the inverter [Indicates whether the IP address is static or dynamically assigned]
Network Subnet Mask	Determines what subnet the IP-address belongs to
Network Gateway	Network point acting as entrance to another network
DNS IP	The DNS IP address
Bus ID (RS-485)	The inverter's identification number on the RS-485 bus
RS485 bitrate	Measurement of data transmitted in a given amount of time [bps]
RS485 parity	Error detecting code: A bit that ensures an odd or even number of bits in a set of bits with value one. Selection: None, Odd, or Even
Bus ID (CAN)	The inverter's identification number on the CAN bus
Set as Master unit	Several inverters connected together in a power control and monitoring system, must have one *master* inverter and the rest must be follower inverters.

6.1.4.3. Inverter Setup

Inverter Setup displays the various data for the specific inverter set during the manufacturer process, and is read-only.

Model	Inverter model
Serial Number	Unique identifier for each inverter. Also to be found on the product label
***DLX* Part No.**	Identifier for each inverter hardware configuration within *Danfoss*
***DLX* Revision**	Unique version name for keeping track of the development of different inverter revision
GUI Software Part No.	The GUI[1] software part number.
GUI Software Revision	Revision number for the GUI software
GUI Hardware Part No.	Identifier for the GUI-card hardware
GUI Hardware Revision	Revision number for the GUI hardware
SW1 Part No.	The DSP1[2] software part number.
SW1 Revision	Revision number for the DSP1 software
Control Board Part No.	DSP-card hardware part number
Control Board Revision	Version name for the DSP control card hardware
Main Board Part No.	Identifier for the PCB[3] hardware.
Main Board Hardware Revision	Unique revision number for keeping track of the development of different main board revisions
SW2 Part No.	The DSP2 software part number
SW2 Revision	Revision number for the DSP2 software

1. GUI = Graphical User Interface, which allows interaction with the inverter through the display.
2. DSP = Digital Signal Processing, which is a microprocessor controlling the power conversion in the inverter.
3. PCB = Printed Circuit Board, which hosts all the components and subsystems of the inverter.

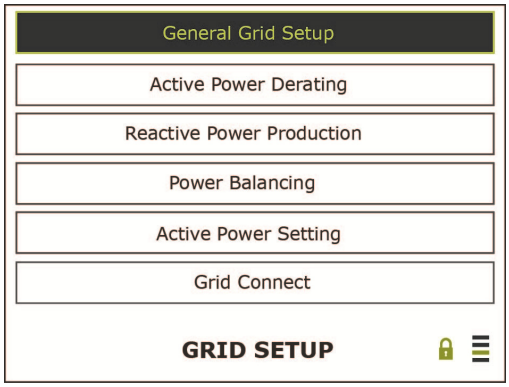
6.2.4.4. Plant Setup

Plant Setup displays useful information about the PV plant, which can be changed using the *Owner* password.

Company/Customer Name	The customer / owner name
Site	The site name
Installation Date	May be used for setting the install date
Service Date	May be used for setting the most recent service date
Responsible	Field for keeping a note of the company/person responsible for service
Unit Name	This text string is displayed in the master unit's list of connected inverters
Message	An extra message field for additional notes
Plant Apparent Power	The product of voltage and current from the entire PV plant [kVA]

6.2.4.5. Grid Setup

Grid Setup displays grid settings based on the selected country. The settings can be changed within **5 hours** after *Start Up* using the *Owner* password. Thereafter it is only accessible by using the *Installer* password, which may only be obtained by the installer contacting *Danfoss*.



Up or ***Down*** – Navigate through the submenus
Enter – Select submenu/confirm

General Grid Setup

General Grid Setup displays grid parameters related to the selected grid standard.

Country	Grid code of installation
Country code	Name of the grid protection standard
Grid nom voltage	Nominal voltage of the grid on site
Grid nom frequency	Nominal frequency of the grid on site
Feeding phase	The phase the inverter is connected to: TN/TT: Not set, L1, L2, L3 IT: Not set, L1-L2, L1-L3, L2-L3
Voltage limit min	Lower disconnection limit of the grid voltage on site
Voltage limit max	Upper disconnection limit of the grid voltage on site
Voltage time limits min	Minimum disconnection time limit
Voltage time limits max	Maximum disconnection time limit
Frequency limits min	Lower disconnection limit of the grid frequency on site
Frequency limits max	Upper disconnection limit of the grid frequency on site
Frequency time limits min	Minimum disconnection time limit
Frequency time limits max	Maximum disconnection time limit
AC volt avg turnoff	Limits for disconnection based on an average voltage over a certain time period. eg. average voltage of >253Vac over 10 minutes

Active Power Derating

Active Power Derating displays limits related to active power according to the selected grid standard.

Name	Name of the grid standard for active power
Enabled	Enables or disables the active power derating
Start frequency	Frequency at which the active power derating starts
Disconnect frequency	Frequency at which the power derating stop and the inverter disconnects from the grids
Slope	Slope of the active power curve in % / Hz
Recovery Rate	Recovery rate of the inverter in % / min

Reactive Power Production

Reactive Power Production displays the method used to control reactive power production according to the selected grid standard.

Name	Name of the grid standard for reactive power
Method	Method used to feed reactive power: *disabled*, *CosPhi (P)* based on characteristic curve or *CosPhi (fixed)*
PF Setpt	Fixed power factor value. Used if method is set to *CosPhi (fixed)*
No. of pnt	Number of X/Y points used for characteristics curve, with a maximum of 8 points. Used if method is set to *CosPhi (P)*
PntX1 – PntX8	"X" point: Defines percentage of active power. Used if method is set to *CosPhi (P)*. Automatic set as a result of grid code
PntY1 – PntY8	"Y" point: Defines *CosPhi* setting per unit. Used if method is set to *CosPhi (P)*. Automatic set as a result of grid code

Power Balancing

Power Balancing displays information related to power balancing according to the selected grid standard.

Name	Name of the grid standard for power balancing
Enabled	Enabled or disabled device: Yes/No
Imbalance Limit	Power per phase balancing: Maximum allowed phase imbalance limit[VA]

Active Power Setting

Active Power Setting information related to active power setting according to the selected grid standard.

Name	Active power settings profile name
Enabled fixed	Enable fixed active power limit: Enabled/Disabled
Active power setpt.	Fixed active power limit [W]

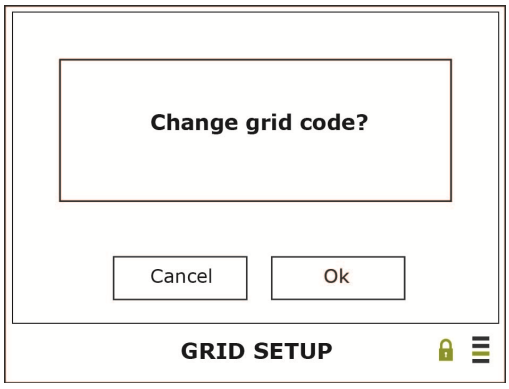
Grid Connect

Grid Connect displays limits related to reconnection of the inverter according to the selected grid standard.

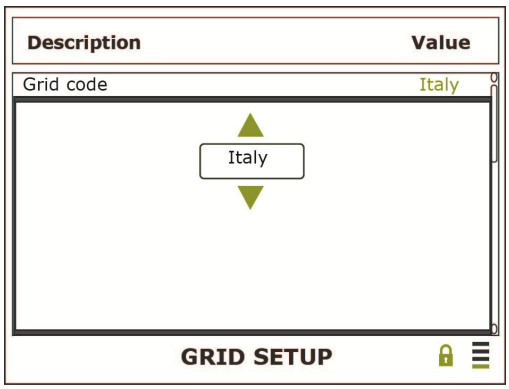
Name	Name of grid connect standard
V_{AC} min connect	Minimum voltage for reconnection to grid
V_{AC} max connect	Maximum voltage for reconnection to grid
f_{AC} min connect	Minimum frequency for reconnection to grid
f_{AC} max connect	Maximum frequency for reconnection to grid

6.2.4.6. Change the Country Settings

- From the *Main Menu:* Select *Setup* >General *Grid Setup* > *Grid Code*.
- ***Enter*** - Confirm.
- After **5 hours** of feeding-in power to the grid the *Installer* password must be used to change the grid code settings. The *Installer* password is available for installers and grid operators only by contacting *Danfoss*.
- The question "*Change grid code?*" appears in the display.



OK – Continue
Cancel – The operation is cancelled



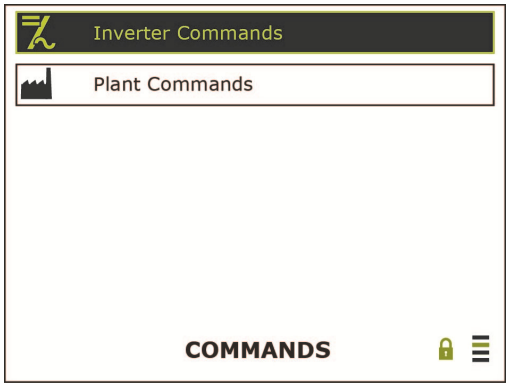
Up* or *Down – Select the respective country
Enter – Confirm

Left – Back
Right – Next
Enter – Confirm

- After the country settings are changed, the screen will return to the *Grid Setup* screen, showing the new grid settings.

6.2.5. Commands

Commands give the ability to delete stored data in the inverter logger using the *Owner* password.



Up or ***Down*** – Navigate through the submenus
Enter – Select a submenu/confirm

Figure 6.2.11: Submenus to Commands

6.2.5.1. Inverter Commands

Inverter Commands gives the ability to delete events saved in the inverter data logger to provide storage space.

Delete Energy Log	Deletes the energy log items and summarized values of the inverter
Delete Data Log	Deletes the 15 minutes average power values of the inverter
Reset Web Admin Account	Resets the web administrator account back to default. *User* is set to ***admin*** and *Password* to ***admin***

For installations in Italy:

Self-Test	Start Self-Test
Result Self-Test	View the results from the last run Self-Test

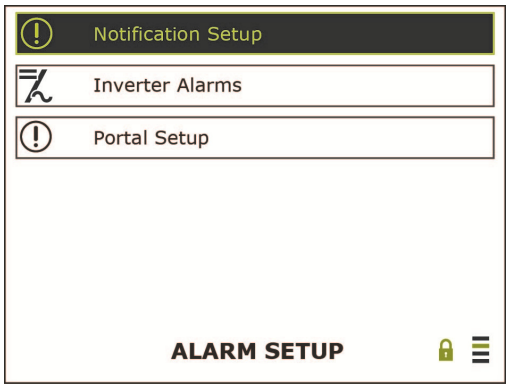
6.2.5.2. Plant Commands

Plant Commands gives the ability to delete events saved in the data logger of the **master** inverter to provide storage space.

Delete Energy Log	Deletes the energy log items and summarized values of the plant
Delete Data Log	Deletes the 15 minutes average power values of the plant
Reset Number of Inverters	Update if inverters are added or removed from the plant
Rebuild plant energy log	Rebuilds the plant energy log based on the energy logs of the inverters currently connected and running in the system. This process may take several minutes.

6.2.6. Alarm Setup

Alarm Setup enables configuration of an email account, so the inverter can send information about energy production, status and operation mode to one or more receivers. Changes require use of the *Owner* password.



Up or ***Down*** – Navigate through the submenus
Enter – Select a submenu/confirm

Figure 6.2.12: Submenus to Alarm Setup

6.2.6.1. Notification Setup

In *Notification Setup* parameters needed for the inverter to send notifications about mode and status on e-mail must be typed in.

User Name	User name for the mail server
Password	Digits, letters and symbols making up the user password for the mail server.
Sender email address	A valid email address, eg: xxxx@xxxxxx.xxx, required to be able to send notifications
Receiver email 1	Mail address for recipient 1
Receiver email 2	Mail address for recipient 2
SMTP server	The IP address of the SMTP server for enabling delivery of emails. Can only be an IP address (ie. numeric).
SMTP port 1	Sets the SMTP port number for SMTP server. Default is 25 (initially shown as 0)

E-Mail Set-up

For enabling the inverter to send e-mails a SMTP server is needed, which transfers the mails to the receiver(s). Most companies have their own server, while normal households most likely have to use one from their ISP.

NOTICE

If the inverter is moved to another network not operated by the same ISP, a new server may need to be assigned.

Procedure

Go to the inverter menu *Alarm Setup>Notification Setup*. Fill out the text fields (Refer to *6.2.6.1. Notification Setup*).

- **User Name and password:** Usually provided by the Internet Service Provider.
- **Sender email address:** This is the e-mail address appearing in the *From* - field when receiving mails from the inverter. It must be configured as follows: *xxxxxx@xxxxxx.xxx*.
- **Receiver 1 and 2:** The recipients' e-mail addresses.
- **SMTP server:** The SMTP's server address.

NOTICE

- All IP addresses related to the inverter and web must be configured within the range that is allowed by the local network
- For GUI revisions below v1.32, the server address must be configured with numbers.
- For GUI revisions v1.32 onwards: if using a domain name, the DNS IP address needs to be specified under ***Setup > Network Setup***.
- Be aware that the ISP provider can change the SMTP IP address without any notification. If the e-mail reports suddenly stops, do an *nslookup* to see if the IP address has been changed!

6.1.6.2. Inverter Alarms

In *Inverter Alarms* the settings of notification types and time intervals of the inverter's e-mails to the receiver(s) must be typed in.

Notification time	Time interval (hours) for e-mailing information about the energy production
Notification time	Time interval (minutes) for e-mailing information about the energy production
Interval	Interval between the notifications (minutes)
Send production on email 1	Specified time for sending information about energy production to email 1
Send mode on email 1	Immediately sends notification to e-mail 1 if operation mode changes
Send alarm on email 1	Immediately sends notification to e-mail 1 if warning or alarm
Send production on email 2	Specified time for sending information about energy production to email 2
Send mode on email 2	Immediately sends notification to e-mail 2 if operation mode changes
Send alarm on email 2	Immediately sends notification to e-mail 2 if warning or alarm

NOTICE

Plant Alarms is reserved for future firmware upgrade functions, and is not yet accessible.

6.1.6.3. Portal Setup

Portal Setup displays settings for uploading data to a web portal. 15 minute average energy data is uploaded every hour to the portal. Upload is disabled if the user name is blank. The portal setup is compatible with the Danfoss *CLX portal*.

FTP Server	dw.clxportal.danfoss.com
Interval	Time interval of upload. Options are: none/hourly
Notification time	Reserved for future use
Group name	Name of the group of inverters
Force send report	For testing ftp setup. Forces an upload of a report, irrelevant of schedule

Note: Only an inverter configured as a *master* will upload FTP data. For third-party FTP services, an additional cost may be applied

6.2.7. Event Log

Event Log displays information about inverter's logged events. The events are listed with the most recent event first.

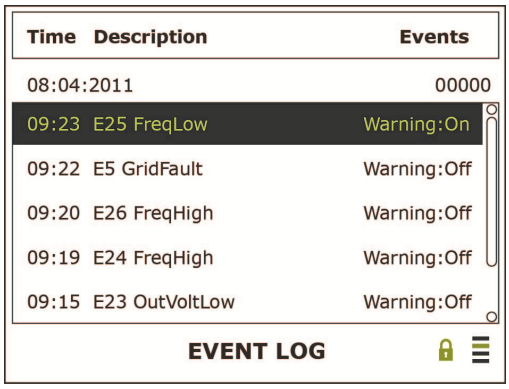


Figure 6.2.13: Events in the log

Up or ***Down*** – Read the different values
Left – Go back to the previous screen
Right – Go forth to next screen

Warning On means that a warning event has occurred.
Warning Off means that an event has cleared.

6.2.8. Statistics

Statistics displays values for the daily, monthly, yearly and total energy harvest, earnings, CO_2 savings and peak power. The information is read-only.

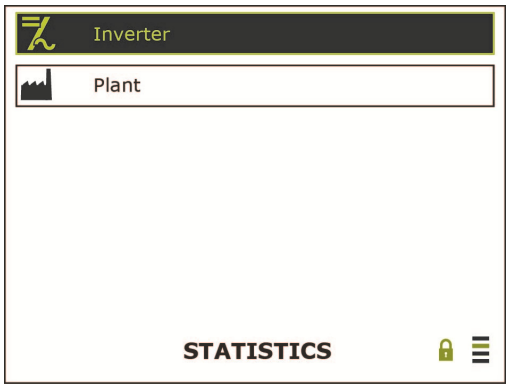


Figure 6.2.14: Submenus to Statistics

Up or ***Down*** – Read the different values
Enter – Select a submenu/confirm

6.2.8.1. Inverter

Inverter displays a summary of the most important statistics of the inverter from today, the last month, the last year and in total since *Start Up*.

Energy	Inverter's total energy production [kWh]
Earnings	Cash value of the feed-in energy in currency/kWh
CO_2 avoided	Avoided CO_2 emissions [kg/kWh] compared to fossil fuel
Peak Power	Inverter's largest instantaneous amount of power production [W]

6.2.8.2. Plant

Plant displays a summary of the most important statistics of the PV plant from today, the last month, the last year and in total since *Start Up*.

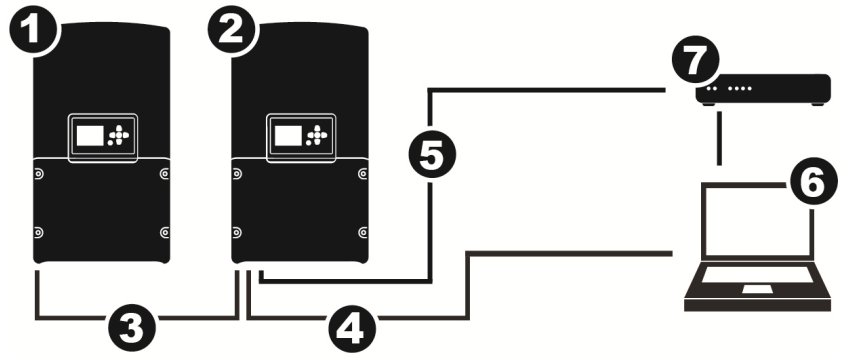
Energy	Plant's total energy production [kWh]
Earnings	Cash value of the feed-in energy in currency/kWh.
CO_2 avoided	Avoided CO_2 emissions [kg/kWh] compared to fossil fuel
Peak Power	Plant's largest instantaneous amount of power production [W]

6.3. Connection between Inverter and Computer

The site performance can be checked remotely by using a computer. The connection can be achieved between the inverter and the computer either directly or via a network.

6.3.1. Without a Network

To connect the inverter and the computer directly a regular Ethernet cable is needed. If the network card in the computer does not support *Autosense*, a crossover cable is needed to create a connection to the inverter.



1. Follower inverter
2. Master inverter
3. CAN bus cable
4. Ethernet cable
5. RS-485 cable
6. Computer
7. Data logger

Figure 6.3.1:Connection without network

NOTICE

With several inverters connected together via CAN bus the Ethernet cable must be attached to the **master** inverter only.

6.3.1.1. IP Address

The computer's and the inverter's IP address must be in the same range. If the inverter's IP address is *192.168.10.X*, the computer's IP address must be *192.168.10.Y*, where X and Y are different numbers between 1 and 254.

Inverter

The inverter's default IP address is *192.168.10.20*. To change the IP address, go to ***Setup***>***Network Setup*** and set the inverter's IP address as required.
To connect the PC and the inverter, the inverter's IP address must be entered into the PC web browser address line.

Computer

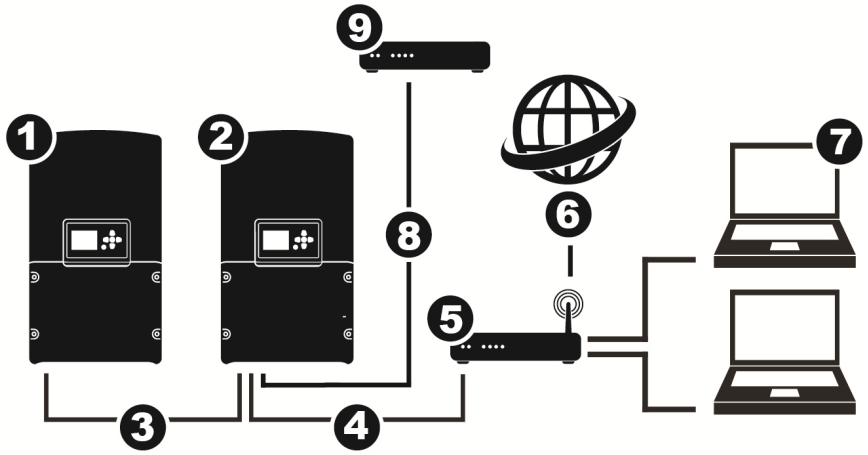
The example below shows the steps to be followed on a *Windows® 7** computer to manually change the computer's IP address. This procedure may vary on computers with operating systems (OS):

1. Open the network menu by clicking ***Start***
2. Click ***Control Panel*** > ***Network and Sharing Center***
3. Click ***Local Area Connection*** > ***Properties***
4. Select ***Internet Protocol Version 4 (TCP/IPv4)*** > ***Properties***
5. Select ***Use the following IP address***
Enter the default parameters: IP address ***192.168.10.10***, subnet mask ***255.255.255.0***.
Click *OK* and *OK*

**Windows is a registered trademark of Microsoft Corporation in the United States and other countries.*

6.3.2. With a Network

If a network is present, the availability of DHCP (*Dynamic Host Configuration Protocol*) can determine the configuration between the inverter and the computer. With DCHP, a router or a switch normally distributes the needed parameters (IP address and Subnet Mask) for devices to operate in the network.



1. Follower inverter
2. Master inverter
3. CAN bus cable
4. Ethernet cable
5. Router/Switch
6. World Wide Web
7. Computer
8. RS-485 cable
9. Data logger

Figure 6.3.2:Connection with network and World Wide Web

Connect the inverter and the PC to the router/switch with a regular Ethernet cable.

6.3.2.1. With DHCP – Dynamic IP Address

Inverter

1. Go to ***Setup***>***Network Setup***.
2. Set the IP address to ***000.000.000.000***. With this setting the router assigns a dynamic (DHCP) IP address automatically to the inverter.
3. Press ***OK***. GUI will restart to configure the new network settings.

6.3.2.2. Without DHCP – Static IP Address

Inverter

1. Go to ***Setup***>***Network Setup***.
2. Set the IP address to a desired, unique address for the inverter (Static). The inverter's IP address must be an unused IP address in the network and in the same range as the computer's IP address.
3. Press ***OK***. GUI will restart to configure the new network settings.

6.3.3. Access from the Internet

In order to make the inverter(s) accessible from the internet, further parameters must be set within the network settings.

1. The inverter must be assigned a *static* IP address in the local network. Refer to the previous section.
2. *Port Forwarding* must be set up within the local network router. Port number *80* of the router is for Web traffic (HTTP), and must be forwarded to the inverter's static IP address. The external IP address of the router can be found at *http://www.whatismyip.com* or similar web services, or by asking the relevant Internet Service Provider (ISP).

NOTICE

If the external network is assigned a *dynamic* IP address from the ISP, this IP address is unlikely to remain constant over a long time period. It is possible for the inverter owner to set up an account with a company that provides dynamic DNS services for commercial and private users, which allows the user to have a hostname (such as: *yourname.serviceprovider.org*) that points to a computer with an IP address that regularly changes.
In order to have the dynamic DNS service operating correctly, the owner's router must be capable of reporting its IP address to the dynamic DNS service provider. This will most likely be present in the router settings section which asks for the details of the user account with the dynamic DNS service provider.
If the owner's router does not report its IP address to the dynamic DNS service and has a dynamic external IP address, then periodically a manual update of the dynamic DNS settings will be required.

3. When this is completed it should be possible to reach the DLX webserver by typing the external IP address of the local network or the web address (if a dynamic DNS service is used) in the computer's web browser.

6.4. Internal Web Server

The inverter has an internal, onboard web server providing detailed information about the operation, warning/alarms and energy production from the inverter/plant.

- The web page is best viewed in *Firefox 6.0* and *Internet Explorer 8.0* or later versions.
- From the web page certain inverter settings can be changed after applying the correct user name and password.
- Type the inverter's IP address in the computer's web browser.
- Default administrator account is: **User:** *admin*, **Password:** *admin*.
  This can be changed by user, and should be changed if the web server is connected to the internet.

6.4.1. Home

The *Home* screen is the standard display, which is always shown when opening the web server.

Figure 6.4.1: Standard display

- **System status** shows the status and operating mode of the inverter or the PV plant. Current power production and input values on DC and AC side are listed to the right.
- **PV plant**: More detailed information for specific inverters in a plant can be found in the drop-down menu under *Plant* to the right.
- **Production status** shows the energy yield for the current day, month and year.
- More detailed numbers of the production status can be viewed by guiding the mouse button over the graphs.

6.4.2. Statistics

Statistics gives a graphical overview over the energy production from the current week and the last 12 months.

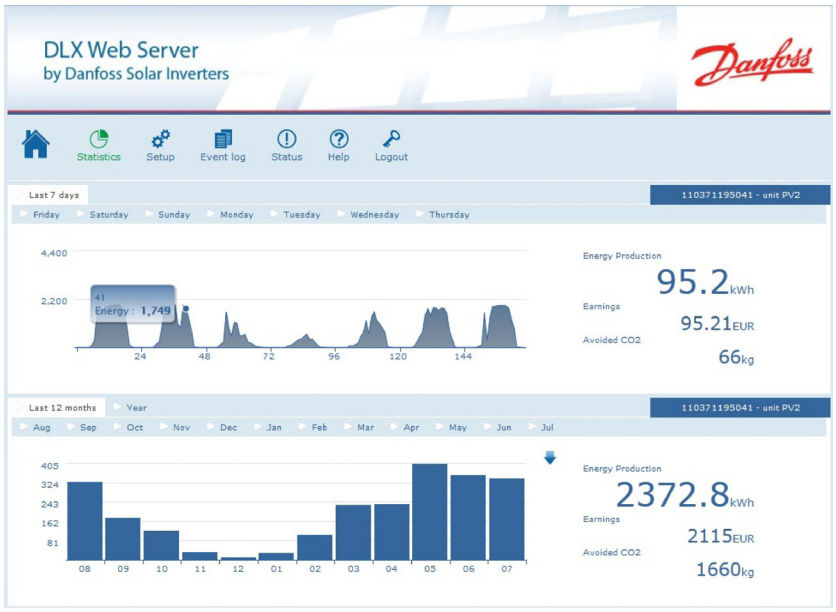


Figure 6.4.2: Statistics

- **PV plant**: More detailed information for specific inverters in a plant can be found in the drop-down menu under *Plant* to the right.
- More detailed values from the production data can be viewed by guiding the mouse button over the graphs.
- In newer GUI revisions, the energy log may be downloaded by clicking on the 'down' arrow (will be displayed if available).
- The energy data downloaded is determined by the unit selected in the dropdown box. This functionality may not work on certain mobile devices.

The data may be imported into a spreadsheet program, with the data format as follows:
<dp time="YYYY-MM-DD HH:MM:SS">
<en>WWWW</en>
<pw>PPPP</pw>
<va>€€€€</va>
</dp>

dp: Datapoint – the date and time stamp of the entry
en: Energy for the interval in Wh (watt-hours)
pw: Peak power for the interval in watts
va: Earnings/savings for the interval with two decimal points, in the chosen currency, eg. '7778' is 77.78 Euros

6.4.3. Setup

Setup gives different settings and information of every inverter in the PV plant.

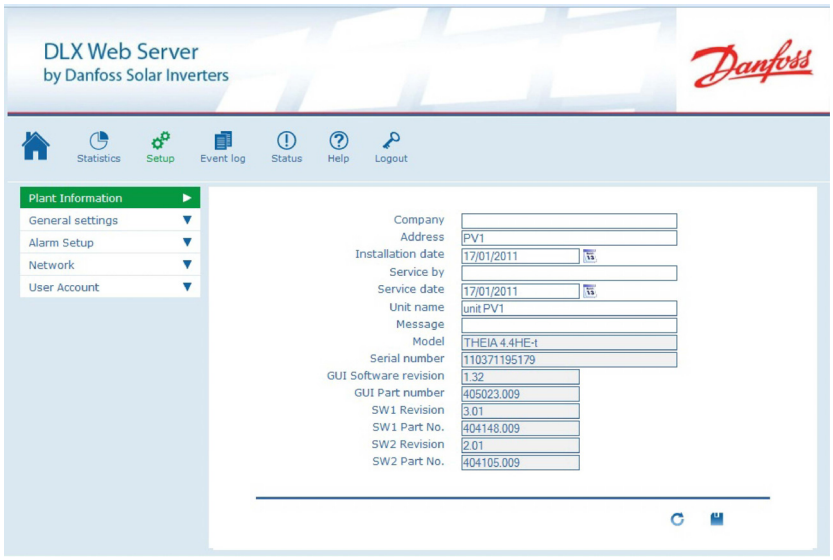


Figure 6.4.3: Setup

- **Plant Information** shows important characteristics of every inverter in the PV plant. Model, serial number, revision and part no. information are all read-only.
- **General Settings** shows date and time, CO_2 - rating and rate and currency of the earning. Settings can be modified.
- **Alarm Setup** shows information related to notifications and alarms from the inverter/plant.

Notification Setup:	Type username and IP address/host name of the SMTP server, the IP address of the inverter and mail address of the receiver(s).
Alarm Setup:	Type time for sending email messages (0 – 23 h) and the interval of the messages (1440 min = 1 day).
Portal Setup:	The inverter may upload energy data to an FTP-server. Specify the server address (either IP address or DNS) in the FTP Server IP field, and optionally a username and password if needed. The data will be uploaded every hour. **Note:** only an inverter configured as a *master* will upload FTP data. For third-party FTP services, an additional cost may be applied.

- **Network** shows the parameters related to the sending and receiving of email messages. Type the IP address (configured with ***numbers*** like ***192.168.10.20***), network subnet mask and gateway. Refer to *6.3.1.1. IP Address*.
- **User Account** shows the current user accounts and provides the ability to setup and/or change user names and passwords. The different levels are:

1. Guest:	Access level 1: Read only access to all values.
2. Owner:	Access level 2: Read and write access to all values and set levels except the installer related values such as network settings and user accounts.
3. Admin:	Access level 3: Read and write access to all levels and set values.

6.4.4. Event Log

Event Log shows information about events that the inverter has logged. The events are listed with the most recent event first. The information is read-only.

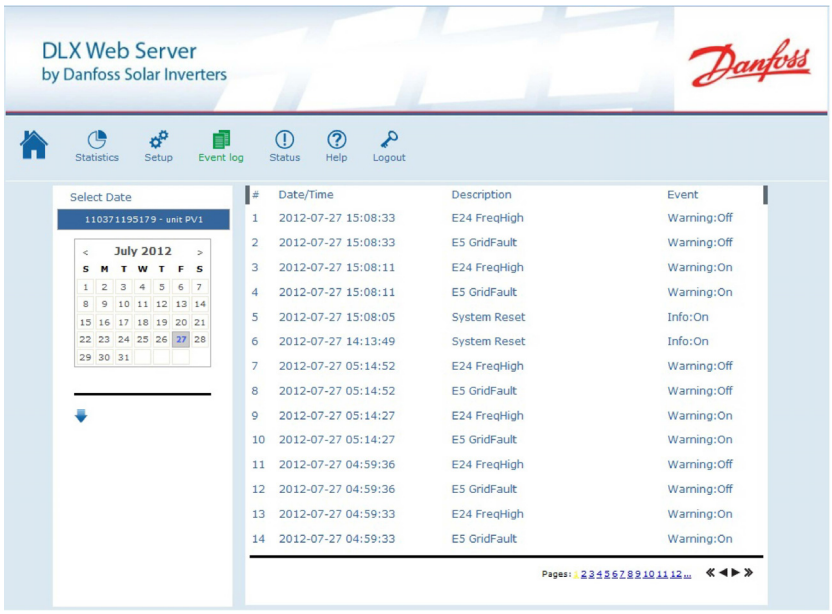


Figure 6.4.4: Event Log

- Recent events can be viewed by navigating directly to the different pages in the list on the bottom of the screen.
- Events from previous months and years can be viewed by specific dates using the calendar to the left.
- The most recent events in the event log may be downloaded as a text file by clicking the “down”-arrow (will be displayed if available).
- The latest events from the *clients* may be displayed and downloaded. This is only available if the *clients* also have the same or newer GUI revision as the *master* unit.

6.4.5. Status

Status displays any warnings and alarms in the plant, and gives an overview of the plant's technical characteristics and energy yield. The information is read-only.

Figure 6.4.5: Status

- **Alarms** tab identifies any specific warnings or alarms in the plant, with any activated items highlighted.
  The *Extended Status* lines are used by Danfoss service personnel to help diagnose possible faults.
- **Overview** provides input parameters from the PV panels to the inverter/plant, the output parameters from the inverter/plant to the grid as well as earnings, avoided CO_2 emissions and total energy production with peak values from the inverter/plant.
- **Plant** (available in a unit configured as a *master* when selecting '*Plant*' in the drop down list) provides a snapshot of the connected inverters, status and energy production information. To refresh the information, click the '*Plant*' tab.

7. TROUBLESHOOTING

This chapter contains useful information if the inverter malfunctions during start-up or operation. Start by checking that the installation is carried out correctly, and then check the information in *7.2. Table of Events* for possible solutions. If this does not help solve the problem, please contact the system installer.

7.1. Check List by Failure

If the inverter does not feed power to the grid, try to solve the problem by checking:

☑ That the irradiation is sufficient to generate power (>7 W).
☑ That both the AC circuit breaker(s) and DC switch(es) are **ON**.
☑ That the operation mode of the LEDs is normal. Refer to *LEDs*.
☑ That there are no warnings or alarms in the display. Refer to *7.2. Table of Events*.
☑ That all connection points in the system are properly tightened.
☑ That the values of the PV voltage, current and power match those in the display.

If all these items are OK, and there is still no power fed to the grid, please contact the system installer.

7.2. Table of Events

The inverter automatically identifies operational issues and displays the messages on the screen. Detailed information about warnings and alarms can be found in the *Event Log* menu. Refer to *6.2.6. Event Log*.

Messages that can appear in the display:

W = Warning: inverter continues to operate at highest possible capacity (Yellow LED
A = Alarm (Red LED)

The Display Message code number (E01, E02, etc..) is the code shown in the event description as displayed in the Event Log of the webserver view:

Table 7.1: Description of messages appearing in the display during inverter failure

Display Message	Description	Action
Panel fault (**W/A – E01**)	PV module failure	- Contact the module supplier*
Input circuit breaker open (**A – E02**)	DC switch(es) is open	- Turn ON the DC switch(es)* - If already ON, contact the system installer
Inverter failure (**W/A – E03**)	Inverter failure	*
Output circuit breaker open (**A – E04**)	AC circuit breaker(s) is open	- Turn ON the AC circuit breaker(s)* - If already ON, contact the system installer

Display Message	Description	Action
Grid fault (**W/A – E05**)	No detection of the grid, not able to synchronize with the grid or fault within the country-settings	- Verify if the AC circuit breaker is ON and operational - Measure that the grid voltage is present at the AC terminals - Check that the DC switch(es) is ON and that the DC power is > 7W - Check that the country settings have been successfully set in *Setup>Grid Setup* - If country is set to Italy, has the *Self-Test* failed. Run test again
GUI fault (**W/A – E06**)	Display is not responding	- Turn off the AC side. Wait for 3 seconds and then turn on again. Wait 30 seconds for the GUI to turn on - If still fault, contact your distributor
High voltage on input side (**A – E07**)	DC voltage threshold of 600 V_{DC} is exceeded	- Contact system installer
Low voltage on input side (**A – E08**)	DC voltage is too low to operate the inverter	- Fault is cleared automatically when PV voltage exceeds 230 V - If the inverter remains in this fault during daylight, and the V_{DC} is >230V, contact your distributor
Low PV isolation resistance (**W – E09**)	PV isolation resistance is below permitted level	- The grounding setup is configured incorrect - Check the jumper for the grounding setup *(Jumper Position for the System Grounding Setup*) - If the jumper is correct positioned, contact the supplier
Failure on DC side (**W/A – E10**)	Inverter failure on the DC side	- Failure on the DC side. Other **W/A** will be displayed - If the inverter is in *Shutdown*, turn off the AC side and then the DC side. Wait for 30 seconds, then turn on the AC side and then the DC side - If the fault persists, contact your distributor
Failure on AC side (**W/A – E11**)	Inverter failure on the AC side	- Failure on the AC side. Other **W/A** will be displayed - If the inverter is in *Shutdown*, turn off the AC side and then the DC side. Wait for 30 seconds, then turn on the AC side and then the DC side - If the fault persists, contact your distributor
High inverter temperature (**W/A – E12**)	Maximum permissible internal inverter temperature is exceeded	- Check that the ambient temperature is within the specification. Refer *to 10. Technical Data* - Check if the ventilation is sufficient, the minimum distances are compliant with those stated in this *User Manual* and the inverter is shielded from direct sunshine - Clean ventilation. Refer to *8.2.7. Ventilation*

Display Message	Description	Action
Low inverter temperature(**W/A – E13**)	Low internal inverter temperature	- Contact your distributor
Current / power limitation (**W/A – E14**)	PV power exceeds inverter rating	- The inverter will try to start up again when the temperature is within the permissible range again - Check if the ventilation is sufficient, the minimum distances are compliant with those stated in this manual and the inverter is shielded from direct sunshine - Clean ventilation. Refer *to 8.2.7. Ventilation*
Communication failure (**A – E15**)	Internal communication failure	- If the inverter is in *Shutdown*, turn off the AC side and then the DC side. Wait for 30 seconds, then turn on the AC side and then the DC side - If the fault persists, contact your distributor
Fan failure (**W/A – E16**)	Internal air circulation has failed	- Contact your distributor for replacement
Fuse fault (**A – E17**)	One or more fuses or circuit breakers are blown, or the jumper for the grounding setup is positioned incorrect	- Check the jumper position *(Jumper Position for the System Grounding Setup)* - Contact the system installer for DC fuse replacement
Active power limitation (**W/A – E18**)		*
Reactive power compensation (**W/A – E19**)		*
Microprocessor fault (**W/A – E20**)		- If the inverter is in *Shutdown*, turn off the AC side and then the DC side. Wait for 30 seconds, then turn on the AC side and then the DC side - If the fault persists, contact your distributor
Ground current trip (**A – E21**)		*
High AC voltage (**A – E22**)	Too high AC voltage, the inverter stops feeding power	- The inverter will restart when the voltage is within the permissible range - Check that the country settings have been successfully set in *Setup > Grid Setup* - If the failure persists, contact the system installer
Low AC voltage (**A – E23**)	Too low AC voltage, the inverter stops feeding power	- The inverter will restart when the voltage is within the permissible range - Check that the country settings have been successfully set in *Setup > Grid Setup* - If the failure persists, contact the system installer

Display Message	Description	Action
High frequency on output side (**W/A – E24**)	The frequency of the utility voltage is above the upper limit	- The inverter tries to restart when the frequency is within the permissible range - Check that the country settings have been successfully set in *Setup > Grid Setup* - If the failure persists, contact the system installer
Low frequency on output side (**W/A – E25**)	The frequency of the utility voltage is below the lower limit	- The inverter tries to restart when the frequency is within the permissible range - Check that the country settings have been successfully set in *Setup > Grid Setup* - If the failure persists, contact the system installer
High output DC current (**W/A – E26**)	Too high proportion of DC current in the grid feed	- The inverter tries to restart when the fault is cleared - If the fault still occurs, contact your distributor
Output current imbalance (**W – E27**)	Imbalance in the output current between the phases (3 phase only)	*
Grid fault, still running (**W – E28**)	Fault ride-through	*
VDR fault DC side (**W – E29**)	The varistors on the DC side are damaged.	- Contact your distributor for new parts

* Reserved for future use

8. MAINTENANCE

This chapter explains how to switch OFF and discharge the inverter safely. It also provides an overview of important regular maintenance procedures to ensure trouble-free operation of the *DLX* inverters. Finally, it is explained how to remove and return the inverters.

8.1. Switch-Off

Always turn OFF and disconnect the inverter in the following order prior to maintenance work or repairs:

DANGER

Never perform work on the inverter without disconnecting both the DC and AC side because of deadly voltages present at the terminals.

DC Side

- Turn OFF the DC switch.
- Disconnect the connectors.

AC Side

- Turn OFF the AC circuit breaker(s).
- Let the DC capacitor bank discharge.

WARNING

Lethal voltages may be present inside the inverter after switch OFF, because of a charged capacitor bank. It must be discharged for **1 hour** before performing service or maintenance work on the inverter.

8.2. Regular System Inspections

The *DLX* inverters are manufactured to operate trouble-free for several years. Performing regular maintenance will ensure high efficiency and a long service life.

NOTICE

Only permit qualified persons to perform the work inside the inverter! Maintenance work involving removal of the inverter covers must be performed by qualified persons only, due to the requirements of the product warranty.

8.2.1. Modules

Maintain the PV modules as recommended from the manufacturer.

8.2.2. Cables

Regularly check the cables inside and outside for signs of damage or overheating, i.e. warm conductors or surface corrosion. Replace frayed conductors immediately, find and fix the reason for the damage!

8.2.3. Electrical Connection

Regularly check that the terminals and plugs are firmly tightened, and that the insulation is not deteriorated or corroded. If a combiner box is used, also check the terminals and plugs in the combiner box!

8.2.4. Fuses/Circuit Breakers

Frequently blown fuses or tripped circuit breakers are a clear warning sign of overload, short circuit or ground fault.

- Always determine the reason for blown fuses/tripped circuit breakers prior to replacement/resetting.
- The replacement/resetting must be performed by qualified persons only!

8.2.5. DC Disconnect Switch

To prevent welding of the contacts, thereby extending service life, the DC switch(es) must be operated at least once every 12 months, preferably at night or when the AC is OFF.

8.2.6. Inverter

It is recommended that the inside of the inverter is checked by the system installer for humidity and dust every 3 – 4 years.

8.2.7. Ventilation

The heat sink on the back of the inverter conducts heat away from the electronic components, and must be clean to ensure sufficient cooling performance and thereby prevent yield losses. This is accomplished by using either:

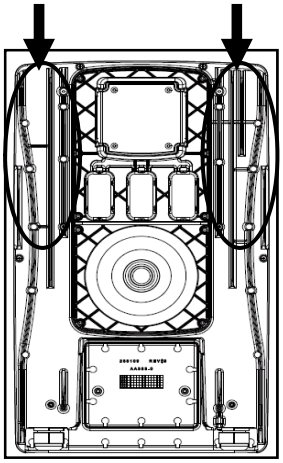


Figure 8.2.4: Heat sink cleaning

- Vacuum cleaner
- Soft brush
- Compressed air

8.2.7. Fan

The fan circulates the air inside the inverter, which distributes heat and thereby maintains the conversion capacity. The replacement of the fan requires removal of the inverter upper cover and must be performed by *Danfoss* authorized service personnel only!

- A message is shown in the display when the fan needs replacement. Refer to *7.2. Table of Events*.
- If the fan fails, the inverter continues to feed the maximum amount of power available until a certain high temperature threshold, at which point it starts to reduce power to protect itself against overheating.

8.2.9. Varistors (VDR)

Varistors have a finite life expectancy, and therefore need regularly inspections (at least once per year). When exposed to transients they degrade and lose their protective function and need to be replaced. The replacement requires removal of the inverter lower cover and the use of the VDR service tool, and must be performed by qualified personnel only!

8.2.9.1. DC Side

- A message is shown in the display when a DC varistor needs replacement. Refer *to 7.2. Table of Events*.
- Replace the damaged varistor with *LX Varistor Kit* ordered from your local *Danfoss* representative, part number 139B0570.
- The two varistors on the DC side are located above the network connection on the left side of the customer connection area.
- Note the orientation of the varistors if they need to be replaced.

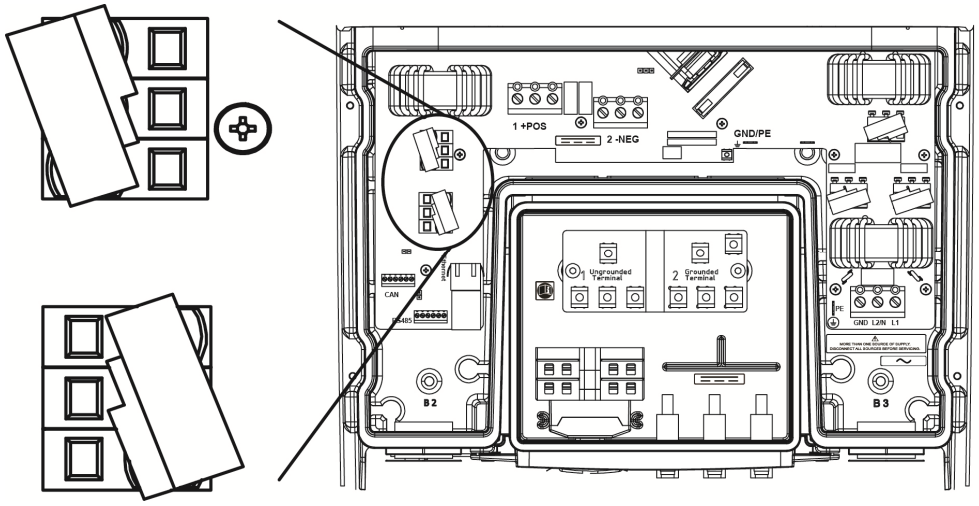


Figure 8.2.5: Varistors on the DC side

8.2.9.2. AC Side

- No alarms are raised regarding the condition of the varistors on the AC side. Therefore, they need to be checked regularly (at least once per year) or after lightning strikes.
- Replace the damaged varistor with *DLX Varistor Kit* ordered from *Danfoss,* part number *139B0570.*
- The three varistors on the AC side are located in the right side of the connection area above the AC terminal area.
- Note the orientation of the varistors if they need to be replaced.

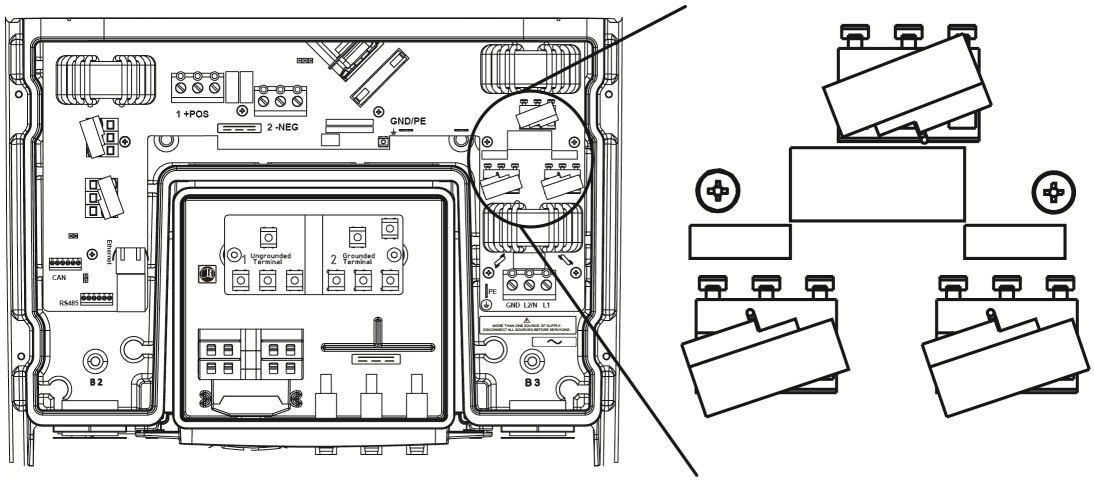


Figure 8.2.6: Varistors on the AC side

Check Varistor

Measure the ohms between the terminal and the bent pin on each varistor as per the below diagrams:

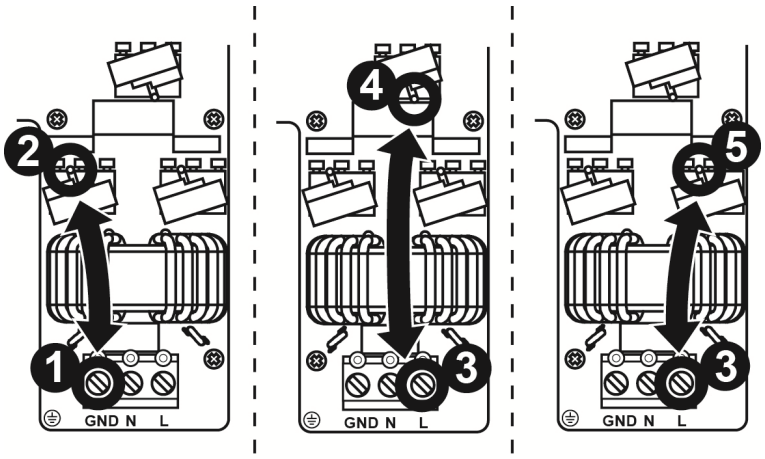


Figure 8.2.7: Checking the AC varistors

Table 8.1: Measure if the varistors are damaged

Measurements	Undamaged	Replace
Between ***GND*** (1) and the ***left VDR*** (2)	0 Ω	∞ Ω
Between ***N*** (3) and the ***middle VDR*** (4)	0 Ω	∞ Ω
Between ***GND*** (3) and the ***right VDR***(5)	0 Ω	∞ Ω

Replacement Procedure

- Use the service tool delivered in the packaging with the new varistors ordered from *Danfoss*. The service tool is designed as a fork, and can open up all terminal clamps simultaneously.

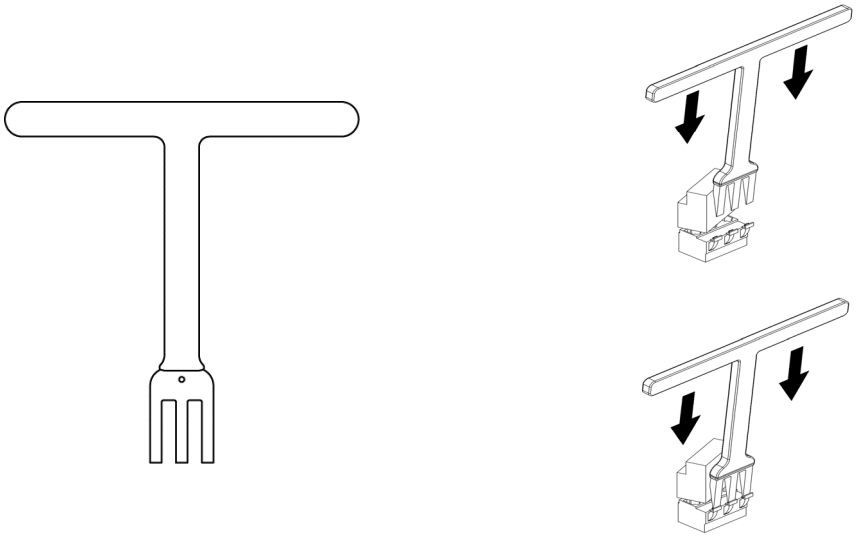


Figure 0.1: Service tool to open the varistor terminal clamps

- Open the terminal clamps and remove the damaged varistor(s).
- Comply with *Figure 8.2.5* and *8.2.6* to get the position of the varistors correct.
- Also use the service tool to open the clamps when inserting the new varistor(s).

8.3. Replace Devices

It is possible to add new inverters, or replace existing inverters, in a PV system.

Follower

- If the replaced inverter is a **follower**, the master inverter will automatically identify the replaced device and put it into operation.
- The device number is automatically maintained.

Master

- If the replaced inverter is the **master** and master functionality is desired, an existing inverter needs to be set up as master. This is done in *Setup>Network Setup>Set as Master unit*. Select *YES*, and an automatic logon-sequence is performed.

8.4. Return and Disposal

When replacing an inverter, it can either be returned to your distributor, to *Danfoss* direct, or disposed of according to local and national regulations. *Danfoss* is committed to its policy of environmental responsibility, and therefore appeals to end users who are disposing of inverters to follow local environmental legislation and to seek safe, responsible means of disposal.

8.4.1. Return

For return to *Danfoss* the inverter should always be in its original packaging or equivalent packaging.

In case of return of the product as a result of inverter failure, please contact your Danfoss inverter supplier.

8.4.2. Disposal

In case of end of service life, the inverter can be returned to your distributor, to *Danfoss* direct, or disposed of in the respective country. The shipping to the distributor or *Danfoss* is paid by the sender.

Recycling and disposal of the *DLX* inverter must be done according to the rules and regulations applicable in the country of disposal. All the inverter packaging material is recyclable.

9. WARRANTY

The inverters are compatible with all relevant standards and are guaranteed to be free of defects from the date of purchase. Please refer to the **Warranty documents** on *Danfoss's* web site *www.Danfoss.com* for more detailed information about the warranty of the inverter. If any questions, please contact your inverter supplier or the *Danfoss* office in your territory.

9.1. Warranty Service

The standard warranty applies for **5 years** after the date of installation, with an option for extension. To maintain the full warranty period, the inverter must be installed within **6 months** after the date of purchase.

NOTICE

To maintain the warranties the inverter must be installed, operated and maintained according to the instructions detailed in this manual and the national and local electrical regulations.

9.2. Warranty Disclaimer

The warranty is void through misuse or when unauthorized repairs are performed on the inverter. The warranty does not cover normal wear and tear of the inverters or costs related to installation and troubleshooting of the electrical system. The warranty is only valid with an identifiable and accepted serial number.

9.2.1. Damage

Danfoss takes no responsibility for damages to the inverter due to:

- Unauthorized persons removing the inverter upper cover.
- Unauthorized modifications made to the inverter.
- Inverter is installed, commissioned, operated or maintained incorrectly.
- Relevant safety regulations and instructions in this *User Manual* being ignored.
- Inverter operating beyond the limit values given in the *10. Technical Data*.
- Inverter exposed to external abnormal conditions such as lightening, storms, fire, vandalism etc.

Refer to the **Warranty document** for details or benefits and exclusions that may apply to you.

10. TECHNICAL DATA

	Parameter	*DLX 2.0*	*DLX 2.9*	*DLX 3.8*	*DLX 4.6*
	AC				
|S|	Rated apparent power	2000 VA	2900 VA	3800 VA	4600 VA
P	Rated active power @ cosphi = 1	2000 W	2900 W	3800 W	4600 W
Q	Reactive power range	0-1600 VAr	0-2320 VAr	0-3120 VAr	0-3680 VAr
	Controlled power factor range	0.8 over-excited, 0.8 under-excided			
$V_{ac,r}$	Rated output voltage	230 V			
$V_{ac,\,min}$; $V_{ac,\,max}$	AC voltage range (P-N. P-P)	230 V±20%, single or split phase			
	Nominal output current	9.0 A	13.0 A	17.0 A	20.0 A
I_{acmax}	Max output current	10.5 A	15.2 A	19.7 A	23.0 A
	AC current distortion (THD %)	2.59%		3.36%	
Cosphi $_{ac,r}$	Power Factor (cos φ)	0.8 over-excited, 0.8 under-excided			
	Night-time power loss	< 1 W			
f_r	Mains frequency	50 Hz			
f_{min}, f_{max}	Grid frequency range	50 Hz ± 5 %			
	DC				
	Nominal DC power	2100 W	3000 W	4000 W	4800 W
	Max recommended PV power	2625 W	3750 W	5000 W	6000 W
$V_{dc,r}$	Nominal voltage DC	220 – 480 V			220 - 480 V
V_{mppmin} V_{mppmax}	MPP voltage-nominal power	230 – 480 V			250 - 480 V
	MPP efficiency	99.9%			
	Max. DC voltage	600 V			
	Turn on voltage	230 VDC			
	Turn off voltage	220 VDC			
	Max current DC	9.5 A	13.5 A	18.0 A	21.0 A
	Max. short circuit current DC at STC	9.5 A	13.5 A	18.0 A	21.0 A
	Min. on grid power	7 W			
	Efficiency				
	Maximum efficiency	97.2 %	97.2 %	97.2 %	97.3 %
	CEC efficiency	96.8 %	96.8 %	97.0 %	97.0 %
	EU efficiency	96.3 %	96.5 %	96.7 %	96.9 %
	Other				
	Dimensions	610 x 353 x 158 mm(169.5 mm with bracket)			
	Mounting recommendation	Wall bracket			
	Weight	19 kg		21 kg	
	Sealing grade	IP65			
	Acoustic noise level	< 37dB (A)			
	Operation temperature range	-25 to +65 °C (Possible power derating above +45 °C)			
	Storage temperature	-30 °C to + 80 °C			
	Relative humidity	4 to 99%			
	Number of PV string inputs	3			
	Number of MPP trackers	1			
	Protection against excessive PV power	Yes			
	Overvoltage category AC / DC	Class B / Class B			
	Reverse polarity protection	Yes			
	Ground fault monitoring	Yes			
	Integral DC switch	Yes			
	PV grounding	Field configurable for ungrounded, positive grounded or negative grounded			
	Topology	High frequency transformer, galvanic isolation			
	Performance monitoring	Graphical colour display with 6 touch sense buttons, 3x LEDs for visual status indication, Built-in Web Server			
	PV connection	SunClix			
	AC/grid connection	Screw terminals			
	Ethernet	1 x RJ45			
	RS-485 / CAN	Screw terminals			
	Functional safety				
	Safety (protective class)	Class I			
	Islanding detection/ loss of mains	Active Frequency Shift			
	RCD type A recommendation	Yes			
	Indirect contact protection	Yes, (Start class I, grounded)			
	Voltage & frequency surveillance	Included			
	Insulation resistance surveillance	Included			
	DC content of AC current surveillance	Included			

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